



# Memoirs of the Indian Meteorological Department

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VOL. XIX.

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III. A DISCUSSION OF THE ANEMOGRAPHIC OBSERVATIONS RECORDED AT PORT BLAIR FROM SEPTEMBER 1894 TO AUGUST 1904.

IV. A DISCUSSION OF THE ANEMOGRAPHIC OBSERVATIONS RECORDED AT DHUBRI FROM NOVEMBER 1889 TO MAY 1896.

BY

W. A. HARWOOD, M. Sc.,  
ASSISTANT, METEOROLOGICAL OBSERVATORY, AGRA,

WITH AN INTRODUCTION BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,  
DIRECTOR-GENERAL OF OBSERVATORIES.

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Published by order of His Excellency the Viceroy and Governor-General of India in Council.

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The discussions of the records of six anemograph stations which follow complete the set of memoirs which Sir John Eliot had planned to write after his retirement. Of these nine form Volume XVIII, and two precede this in Volume XIX; but his untimely death prevented Sir John Eliot from finishing the task that he had set himself. He nearly completed the analysis of the winds of Port Blair and this is published largely as he left it, with some modifications and corrections necessary to bring it into accordance with definite results obtained by other workers: Sir John Eliot also left some notes for the memoirs on Belgaum and Deesa; but those on Dhubri, Jubbulpore and Karachi were practically untouched. An examination of the original data in the course of writing the last five memoirs has shown that the instrumental records of the whole series were in general far from good,\* but after careful consideration it appears that the results are qualitatively, though not quantitatively, true; and it seemed well worth while therefore to ask Mr. W. A. Harwood to carry through the publication of the series. After the lapse of so many years it would involve very much labour to make any attempt to eliminate the various errors in the records, and the last five memoirs have therefore been made very brief, questions of detail being neglected entirely. Thus it was at first intended to add to Sir John Eliot's discussion of the Port Blair data a section giving the harmonic analysis of the winds after eliminating the effects of prevailing winds and convection currents, as has been done by Hann for Dodabetta and Kodaikanal; but the discrepancies due to faulty exposure and inefficient working were so serious that this idea was abandoned. The theoretical winds resulting from the daily pressure variation have however been worked out by Mr. W. A. Harwood for two latitudes and are published as an appendix to the present volume. They may be useful as indicating the relation between the daily variation of the wind and the daily oscillation of the barometer.

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*A discussion of the anemographic observations recorded at Port Blair from September 1894 to August 1904, by SIR JOHN ELIOT, M.A., F.R.S., K.C.I.E.*

*Latitude 11° 41' N Longitude 92° 42' E. Elevation of barometer cistern 91 feet above mean sea level, and of the top of the anemograph tower 30 feet above the ground level.*

The present discussion of the Port Blair anemographic data is probably the most interesting of the series, as Port Blair is the only purely insular and tropical station at which these observations have been hitherto recorded in India.

Port Blair is in latitude 12° N and hence practically in the same latitude as Madras in the Indian Peninsula and Mergui in the Malay Peninsula. It is about 800 miles distant from Madras, and also from Saugor Island at the entrance to the Hoogly, 350 miles from Cape Negrais, the nearest point in Burma, 400 miles from Rangoon and Mergui, and 500 miles from the entrance to the Bay of Bengal (assumed to be in latitude 5° N).

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\* The directions in the records of some anemometers are untrustworthy and in many the velocities lose their accuracy for some years before cleaning.



The island on which the town stands is one of a line which probably represents the unsubmerged portion of a mountain range extending from Cape Negrais to the northern extremity of Sumatra, and which may be regarded as the continuation of the Arakan Yoma. The line of islands includes Preparis, the Cocos Islands, the Andamans and the Nicobars, and divide the Bay of Bengal into two portions, the Bay proper to the west, and a smaller portion, the Andaman Sea, to the east.

The station is situated on a deep inlet which penetrates westwards into the low forest-covered hills of the Great Andaman and nearly unites with a similar inlet on the western side. The entrance of the inlet is nearly closed by Ross Island, a rocky ridge about  $1\frac{1}{2}$  miles long and  $\frac{1}{4}$  mile wide running north and south. This island is well planted with trees, but a suitable site for the observatory was found at its southern end. There is practically no land to the east between the observatory and the Malay Peninsula, but about 10 miles of low hilly country separates it from the sea on the west. To the south, low hills stretch almost continuously for about 20 miles, and to the north, at a distance of about five miles, Mount Harriet rises to a height of nearly 1,200 feet. Local peculiarities of the wind are therefore not likely to be very marked and the records may be accepted as representing correctly the winds of the surrounding portion of the Bay of Bengal.\*

#### METEOROLOGY OF PORT BLAIR AND THE ANDAMAN ISLANDS.

The most important feature of the meteorology of Port Blair, representative of the centre of the Bay of Bengal, is the very small variation of the temperature, pressure and humidity conditions during the year.

Temperature (as represented by the monthly means) has two maximum and two minimum values in the course of the year. The following gives data :—

—	Maximum.	Minimum.	Maximum.	Minimum.
Mean monthly maximum temperature.	92.5 (April)	85.1 (Sept.)	86.9 (Oct.)	85.9 (Dec.)
Mean monthly minimum temperature.	78.8 (,,)	76.5 (,,)	77.3 (,,)	74.9 (Feb.)
Mean monthly temperature.	84.7 (,,)	79.7 (,,)	81.2 (Nov.)	80.2 (Jan.)

Mean monthly temperature is hence highest in April and lowest in September, but its annual range is only 5°. The highest monthly maximum temperature occurs in April and the lowest minimum in February, the range being 17°·6 or little more than half of the diurnal variation in India in the driest months of the year. The highest maximum recorded since the establishment of the observatory is 99°·1 (on the 6th and 8th May 1889) and the lowest minimum 66°·0 (on the 28th December 1875), thus giving an absolute range of 33°·1, during the period of nearly forty years from 1868 to 1904. The diurnal range is greatest in March (14°·5) and least in July (8°·0) and averages 10°·4 for the year.

\* I have left this as expressing the view of Sir John Eliot, but large discrepancies between the readings of the anemograph and anemometer at Port Blair show that the surroundings exercise considerable influence; beyond this the wireless messages that now come in daily show at times a marked disagreement between the wind directions recorded and those to be expected from the isobars.—G. T. W.

The variation of temperature hence may be resolved into a moderate diurnal variation (averaging  $10^{\circ}$ ) and a small annual variation of about  $7^{\circ}$  superimposed on the diurnal variation. These ranges are of course not quite representative of purely sea conditions, being considerably higher than they would be in the entire absence of land.

The variation of pressure is simpler and even less marked than that of temperature. The Barometer reading as is generally the case in India is highest on the average in January and lowest in June. The following gives extreme data :—

—	MONTHLY MEANS.	
	Maximum.	Minimum.
10 A.M. . . . .	29.947 ins. (Jan. & Feb.)	29.768 ins. (June)
4 P.M. . . . .	29.842 „ ( January )	29.689 „ ( „ )
Mean of day . . . . .	29.898 „ ( „ )	29.733 „ ( „ )
Diurnal range . . . . .	.111 in. (March)	.075 in. (July.)

The range of the monthly mean pressure is hence only  $.165$ ". That of the monthly mean including the diurnal range (*i.e.*, the difference between the maximum 10 A.M. and the minimum 4 P.M. pressure) is  $.258$ ". This is only slightly more than a quarter of an inch, of which more than a tenth of an inch is due to the diurnal variation which is independent of weather conditions.

The aqueous vapour pressure, or amount of moisture in the air, is always large. The monthly mean value has two maxima and two minima in the course of the year. The following gives data of the vapour pressure :—

—	Minimum.	Maximum.	Minimum.	Maximum.
8 A.M. . . . .	.781 (Jan.)	.966 (May)	.920 (Aug.)	.935 (Oct.)
4 P.M. . . . .	.814 ( „ )	.960 (April & May)	.918 (Sep.)	.936 ( „ )
Mean of day . . . . .	.807 ( „ )	.959 (April)	.905 (Aug. & Sep.)	.941 (Nov.)

The absolute maximum is in April when temperature is highest, and the minimum in January when temperature is lowest. This variation is evidently the result of local evaporation in the neighbouring sea area and it is noteworthy that the vapour amount is absolutely greatest, not during the south-west monsoon period, but in April when the lightness of the lower air movement and the comparative absence of convectional movement favours the accumulation of aqueous vapour in the lower air strata.

The following gives data showing the chief features of the annual variation of the percentage humidity of the air :—

—	Minimum.	Maximum.	Minimum.	Maximum.
Mean of day . . . . .	78.7 January	87.5 June	86.2 July	89.4 September.

The data for the amount of cloud show only one maximum and one minimum during the year, *viz.*, 7.9 (July) and 2.7 (March).

In the following table are given data of the mean monthly rainfall and number of rainy days at Port Blair, together with the mean monthly rainfall at Nancowry, a station in the Nicobar Islands in latitude 8° N and longitude 93° E.

MONTHS.	PORT BLAIR.		NANCOWRY.
	Mean rainfall of month. Inches.	Number of rainy days.*	Mean rainfall of month. Inches.
January . . . . .	0.90	2.1	2.77
February . . . . .	0.96	1.1	1.87
March . . . . .	0.34	1.0	2.30
April . . . . .	2.94	5.6	4.85
May . . . . .	16.73	18.8	13.53
June . . . . .	17.95	23.2	13.56
July . . . . .	15.46	23.1	12.66
August . . . . .	14.81	23.1	11.71
September . . . . .	18.85	23.3	11.54
October . . . . .	11.68	18.7	14.23
November . . . . .	8.53	13.0	13.45
December . . . . .	5.55	7.5	11.89
Year . . . . .	114.70	160.5	114.36

\* A fall of 0.1" being taken to constitute a rainy day.

There are at Port Blair, as in southern India generally, two periods of maximum rainfall during the year, *viz.*, June and September, *i. e.*, at the beginning and at the end of the full extension of the monsoon into upper India and the corresponding minima are in the months of March and August. Rainfall is small in amount from January to April, but the extension of south-west winds (local in character) in May gives a very large increase at both Port Blair and Nancowry, as is also the case in Tenasserim and Lower Burma in that month. The rainfall of June at Nancowry is on the average the same in amount as in May. At Port Blair however the June rainfall is slightly greater than that of May. A slight decrease occurs during the period of the full extension of the monsoon currents to their limits in the upper Punjab which is succeeded by a brief increase at Port Blair in September, and at Nancowry in October following on the gradual withdrawal of the humid currents. Rainfall decreases in amount during the remaining two months, more rapidly at Port Blair than Nancowry.

The following is a brief sketch of the variation of the meteorological conditions during the year:—

The year may be divided into four seasons, the characteristic features of which differ considerably:—

These are :—

- (1) The north-east monsoon period, including the months of January and February, when light to moderate steady north-east winds prevail over the whole of the Bay area.
- (2) The pre-monsoon transition period from the north-east to the south-west monsoon, during which south-west winds gradually extend from the north southwards over the whole of the Bay area.
- (3) The south-west monsoon period from June to September, when south-west winds (the continuation of the south-east trade-winds) advance northwards over the Bay into northern India, and prevail steadily from July to September.
- (4) The post-monsoon transition period from the south-west to the north-east monsoon, during which north-east winds of continental origin gradually extend from north-west India over the whole Bay area.

*The north-east monsoon period.*—During this period moderate gradients for north-easterly winds varying slightly from day to day obtain over the whole Bay area. Dallas's charts in the Meteorological Atlas of the Indian Seas show that in the south and centre of the Bay winds from northerly directions prevail almost exclusively. The average strength of the winds in January ranges from about force 2 (Beaufort notation) in the north-west angle of the Bay to about force 3·5 in the south. It averages 3·0 to the west of the Andamans, and 2·5 and 3·1 in the north and south of the Andaman Sea respectively. Winds are slightly weaker and more variable in February than in January, the difference in strength being most marked in the centre and south. Temperature is lowest and the air driest in January, while light to moderate winds with lightly clouded skies as a rule obtain. Winds vary considerably in strength with the variation of the gradients which are usually greatest after the passage eastwards of cold weather storms which have given light to moderate rain showers in Bengal and Assam. Moderate to steep gradients obtain also during the maximum and minimum phases of the oscillatory changes in India, which are due to some more general cause than the passage of the cold weather storms and usually independent of the weather conditions. Cyclonic storms are of very rare occurrence in the Bay and the Andaman Sea during the period, and the rainfall at Port Blair is small in amount, averaging less than two inches.

*Pre-monsoon transition period.*—With the commencement of the hot weather in March over Bengal and northern India generally, pressure begins to fall in the interior, and local south-west winds set in on the Bengal coast. These winds gradually extend landwards and seawards. By the end of March they appear to reach about latitude 16° N, and in the latter part of May they usually prevail over the whole of the Bay area. Feeble north-east winds continue in March over the southern half of the Bay, but they do not exceed force 2 to 3 on the average in any part of the centre or south.

In April the mean pressure is uniform over the Bay and light variable winds prevail in the centre of the Bay furthest from the larger hot land areas where there is a large local indraught by day from the neighbouring seas. The mean force of the winds near the Andamans is 2·5 which is considerably less than the force in the neighbourhood of the Bengal and Madras coasts where ship observations show an average force of 3·5.

Pressure continues to fall in May over the interior of India, especially in the north, and feeble to moderate gradients for south-west winds are usually established over the north

and centre of the Bay during the month. The air movement on the whole increases in the Bay, chiefly owing to increasing activity at its centre. Winds on the mean of the month are of force 3.5 in the neighbourhood of the Bengal and Madras coasts, and range between 3 and 4 over the centre and south of the Bay. Occasionally however the conditions of nearly uniform pressure which prevail in April persist during a part of May. During these periods of approximately uniform pressure over the centre of the Bay, conditions are favourable to the formation of cyclonic storms which may develop into fierce cyclones with their characteristic calm centres, storm waves and hurricane winds. Four such storms formed in this season during the period 1895-1904, *viz.*, in 1895, 1897, 1898 and 1904. The storms all formed in an area characterised for some time previously by nearly uniform pressure, light variable winds, moderately high temperature and clear or lightly clouded skies. The lower strata under such conditions tend to become saturated with aqueous vapour, the product of prolonged evaporation.

*The south-west monsoon period.*—In the latter part of May and the first week or fortnight of June south-westerly winds of moderate intensity prevail over the Bay. The movement, as already explained, commences at the head of the Bay in March and gradually extends southwards in April and May. It has been regarded by some meteorologists as the setting in of the south-west monsoon. The rainfall which these sea winds give is restricted to the coast districts of Tenasserim and Burma, and to Bengal and Assam, the greater part of the interior experiencing exceedingly dry hot weather. A comparatively sudden change usually occurs in the Bay area from about the 10th to the 14th and the land winds of the interior are rapidly displaced by humid winds of great steadiness and volume. This change exhibited in the Bay as an advance of a wave of disturbed squally weather with strong winds and much rain forms the commencement or burst of the south-west monsoon.

The character of the change in the air movement is shown by the following data giving five day means for the month of June of each year of the period :—

	MEAN DAILY AIR MOVEMENT AT POET BLAIR IN MILES.									
	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
1st to 5th	131	128	83	148	131	98	105	114	80	191
6th to 10th	91	111	139	149	80	211	259	141	141	234
11th to 15th	116	220	227	206	85	297	320	210	181	228
16th to 20th	221	276	310	108	97	289	267	159	228	231
21st to 25th	174	210	287	235	115	P	142	166	228	215
26th to 30th	267	293	249	198	126	222	125	68	143	273

The advance (marked by a large and sudden increase of the velocity of the winds) occurred in the fourth period of the month in 1895, in the third in six years, and in the second in two years. It is remarkable that, in 1899 the year of the great drought and failure of the monsoon, the increase of velocity was not exhibited in June, and hence the true south-west monsoon was greatly delayed in that year. The change occurs on the

average about the 10th or 11th of the month in the latitude of Port Blair, and the 13th or 14th at the head of the Bay thus progressing at an average rate of about 250 miles per diem. In the majority of years it is accompanied by the formation of a cyclonic storm in the north of the Bay (a list of these storms is given in "Discussion of the Anemographic Observations recorded at Saugor Island"). Such storms only affect the winds over the south and centre of the Bay by intensifying the general movement from south-west. These intensified monsoon winds exhibit practically no shift of direction at Port Blair with the advance of the storm.

After the full establishment of the south-west monsoon, steady south-west to west-south-west winds usually prevail. The only important feature of the air movement is an oscillatory variation of its amount, periods of strong winds alternating with periods of feeble winds. The following gives three examples of such variations in the month of July for the years 1895, 1899 and 1903. The mean daily air movement at Port Blair in July is, it may be noted, 201 miles.

Year.	Period of month of July.	Mean daily air movement of period.	Average daily rainfall of period.
		Miles.	Inches.
1895 . . . . .	1st to 9th . . . . .	162	0.74
	10th to 17th . . . . .	220	0.56
	18th to 20th . . . . .	160	0.16
	21st to 31st . . . . .	273	0.24
1899 . . . . .	2nd to 6th . . . . .	266	0.43
	7th to 9th . . . . .	195	0.09
	10th to 17th . . . . .	237	0.11
	18th to 31st . . . . .	144	0.14
1903 . . . . .	1st to 9th . . . . .	114	0.29
	10th to 14th . . . . .	232	1.18
	15th to 21st . . . . .	169	1.16
	22nd to 31st . . . . .	225	1.20

Corresponding data are given for the month of August in 1897 and 1901 in the following statement. The mean daily air movement at Port Blair in August is 187 miles.

Year.	Period of month of August.	Mean daily air movement of period.	Average daily rainfall of period.
		Miles.	Inches.
1897 . . . . .	3rd to 7th . . . . .	250	0.69
	8th to 10th . . . . .	198	0.21
	11th to 13th . . . . .	240	1.40
	14th to 29th . . . . .	141	0.41
	30th and 31st . . . . .	288	0.12

Year.	Period of month of August.	Mean daily air movement of period.	Average daily rainfall of period.
1901 . . . . .	2nd to 6th . . . . .	Miles, 144	Inches. 1.01
	7th to 16th . . . . .	214	0.00
	17th to 21st . . . . .	178	0.28
	22nd to 24th . . . . .	247	0.17
	25th to 31st . . . . .	138	0.13

The previous data, selected practically at random, exhibit fully the oscillatory variation of the air movement in very variable periods during the monsoon at Port Blair and hence almost certainly over the centre and south of the Bay of Bengal. It is interesting to note that the strength of the winds in what may be termed the positive phase of the oscillatory variation is practically the same at Port Blair as in the burst of the monsoon.

The following gives the mean force of the winds in the sea areas to the east and west of the Andamans for each month of the period (*vide* the Meteorological Atlas of the Indian Seas).

MONTH.	MEAN WIND STRENGTH BEAUFORT SCALE IN BAY AREA TO THE		HOURLY VELOCITY AND CORRE- SPONDING BEAUFORT NUMBER AT PORT BLAIR.*	
	East of the Andamans.	West of the Andamans.	Velocity.	Force.
June . . . . .	4.1	4.8	10.4	1.5
July . . . . .	4.1	4.6	11.6	1.7
August . . . . .	4.0	4.8	10.8	1.6
September . . . . .	3.3	3.7	9.5	1.3

The data indicate that the monsoon winds are stronger in the Bay of Bengal than in the Andaman Sea, that they are most vigorous in July and August and fall off considerably in September. The seasonal variation of the movement at Port Blair is seen to be similar to that in the sea area east of the Andamans.

After the establishment of the south-west monsoon over the Bay area, cyclonic storms form at intervals in the north of the Bay, and advance as a rule through northern India along a trough of low pressure which is one of the more important features of the pressure distribution of the period. At Port Blair the only noticeable effect of such storms on the air movement is to intensify it during their inception and for some days afterwards. The winds are remarkably steady in direction during these periods. Typical examples are shown in the India Daily Weather Reports of 24th to 30th June and 26th to 31st July 1896, 12th to 19th June 1898, and 7th to 13th August 1899; and data regarding others are given in the "Meteorological Atlas of the Indian Seas." These examples illustrate three different types, the first being a storm at the commencement of the season, the second and third storms generated in the north-west

\* See, M. O. London No. 180, page 16 "The Beaufort Scale of Wind Force"—G. C. Simpson.

angle of the Bay of moderate to considerable intensity (the third being in fact one of the most vigorous rain storms of the period), and the fourth, a comparatively rare type of rain storm forming in the north Andaman Sea.

The general meteorological conditions are unchanged from June to August, pressure being highest in the extreme south of India, and lowest in upper India. The gradients are steep in the Bay and Arabian Sea, but vary within wide limits in periods corresponding with the periods of oscillatory variation of the air movement. In September pressure increases rather rapidly in upper India relative to north-east and south India and the gradients decrease in the Bay at the same time that the trough of low pressure shifts considerably in position. Occasionally the conditions in the Bay are favourable for the development of intense cyclonic storms or cyclones. Typical examples of such storms are those of 3rd to 7th September 1895 and 11th to 16th September 1898.

*The retreating south-west monsoon or post-monsoon transition period.*—Pressure increases rapidly in north-west India in October and on the mean of the month is remarkably uniform over the whole Indian land and sea area. It is slightly lower on the average over the Bay area than over the land area.

In the early part of the month the monsoon circulation over the Bay continues to be directed to Burma and Bengal. Light westerly airs prevail in the Gangetic plain extending eastwards as the south-west monsoon current weakens and contracts seawards. Usually about the middle of the month, pressure increases in Burma and Bengal relative to the south and centre of the Bay and a shallow belt of low pressure stretches in an east and west direction across the Bay. The monsoon winds recurve round this low pressure belt and are now directed to the west coast of the Bay, where they give occasional general rain. Depressions frequently form in the low pressure area, and march westwards to the Ganjam or the Coromandel coast giving rainfall along their paths. Pressure continues to increase in northern India and the belt of low pressure shifts southwards down the Bay. Its axis is usually in about the latitude of Port Blair in November, in the extreme south of the Bay in December and before the end of the latter month it is usually absorbed or transformed into the equatorial low pressure belt of the north-east monsoon period.

The south-west monsoon current hence curves round in the south and centre of the Bay giving frequent and heavy rain which steadily diminishes at Port Blair and in the Nicobars from October to December. In the latter month the rain-storms form in the belt to the east of Ceylon and the south Coromandel coast, between a region of north-east winds in the Bay and of humid south-west to west winds at the entrance to the Bay. They rarely develop into complete and well-marked cyclonic circulations, but pass westwards as areas of heavy rain and squally weather.

Cyclonic storms form at intervals during the period. The conditions are favourable to slow development and prolonged growth with the result that the storms occasionally attain the intensity of cyclones. Owing to their originating in the centre or south of the Bay, Port Blair is frequently visited for short periods by vigorous cyclonic winds, moving about a centre to the west of the station. Typical examples of such storms are those of the 9th to 12th December 1895, 21st to 24th October 1897, 4th to 12th November 1898, 27th to 31st October 1903, and 12th to 15th November 1903.



The table below shows the character of the winds over the sea areas to the west and east of the Andamans, together with that at Port Blair for the season.

MONTH.	MEAN WIND STRENGTH IN BAY AREA. (BEAUFORT SCALE).		MILES PER HOUR AND CORRESPONDING BEAUFORT NUMBERS OF WINDS AT PORT BLAIR.	
	West of the Andamans.	East of the Andamans.	Velocity.	Force.
October . . . . .	3.2	3.0	6.3	0.8
November . . . . .	3.4	3.1	6.7	0.8
December . . . . .	3.0	3.5	7.3	0.9

#### DISCUSSION OF THE WIND RECORDS.

The present discussion is based on the records of wind direction and amount taken at Port Blair during the ten year period—September 1894 to August 1904.

Summaries of the data are given in Tables 1 to 6 and plates XXX to XLII of the appendix.

*Distribution of wind direction during the year.*—It has been pointed out in the section on the meteorology of Port Blair that winds from north-easterly directions predominate from November to March, or for five months of the year, and winds from south-west directions during the five months from May to September. In the transition months of April and October, winds are very variable.

In January and February, winds from northerly directions prevail almost exclusively in the centre and south of the Bay. The following gives data showing the percentage distribution of the winds according to direction at Port Blair during the period.

MONTH.	PERCENTAGE OF WINDS FROM					
	N. W.	N.	N. E.	E.	S. E. to W.	Calm.
January . . . . .	6.5	36.1	41.9	11.6	0.9	3.1
February . . . . .	13.8	30.4	34.3	13.1	3.7	4.0
March . . . . .	16.1	26.9	27.2	16.8	6.1	6.0

Less than one per cent. of the winds are from directions between W. and S. E. in January, and less than four per cent. in February.

In the following table is given the percentage amount of wind from these directions :—

MONTH.	PERCENTAGE AMOUNT OF WIND FROM				S. E. to W.
	N. W.	N.	N. E.	E.	
January . . . . .	3.5	33.4	45.3	16.6	1.2
February . . . . .	8.4	26.3	40.7	10.7	4.9
March . . . . .	10.9	24.1	36.1	22.8	6.2

The percentage amount of wind from the north-east is greater than the percentage number of winds from that direction or, in other words, winds are strongest from the prevailing or dominant direction. Also winds become slightly more variable, or come from directions other than the prevailing north-east in increasing amount with the advance of the season.

The following gives data for the months of March, April and May, exhibiting the gradual transition from north-east to south-west winds:—

MONTH.	PERCENTAGE NUMBER OF WINDS FROM				Percentage of calms.
	N. W. to N. E.	E.	S. E. to S. W.	W.	
March . . . .	70.2	16.8	4.1	2.0	6.9
April . . . .	48.7	19.4	18.0	7.5	6.4
May . . . .	32.9	5.8	37.6	20.9	2.9

North-easterly winds are predominant in April as in March, but winds from southerly directions are four times as numerous. In May the relations are reversed, and winds from southerly directions are somewhat more frequent than from northerly.

The same changes are indicated by the percentage amounts of wind:—

MONTH.	PERCENTAGE AMOUNT OF WIND FROM			
	N. W. to N. E.	E.	S. E. to S. W.	W.
March . . . . .	71.1	22.8	4.7	1.5
April . . . . .	41.3	28.8	24.7	5.3
May . . . . .	28.0	7.5	45.4	19.1

During the south-west monsoon period, from June to August, winds are chiefly from south-west to west. Winds from north-westerly directions, due to the presence of low pressure conditions accompanied by heavy local rain in Burma or the north of the Andaman Sea, are of occasional occurrence. The following table gives data:—

MONTH.	PERCENTAGE NUMBER OF WINDS FROM					
	N. to S. E.	S.	S. W.	W.	N. W.	Calms.
June . . . . .	6.2	11.0	30.3	28.2	13.2	2.2
July . . . . .	5.7	12.1	48.3	26.5	7.0	0.5
August . . . . .	4.2	8.2	41.1	32.8	12.0	0.8
September . . . . .	13.8	11.6	28.8	26.6	14.4	4.7

Winds from west and south-west form more than 70 per cent. of the total observations. The wind become more variable in September, those from west and south-west being barely 55 per cent. of the total number, whilst those from directions N. to S. E. increase from 4.2 per cent. in August to 13.8 per cent. in September.

The following gives corresponding data for the percentage amount of wind:—

Month.	PERCENTAGE AMOUNT OF WIND FROM					
	N. to S. E.	S.	S. W.	W.	N. W.	Total from S. to N. W.
June . . . . .	6.7	12.4	44.7	26.2	10.0	83.3
July . . . . .	6.5	14.4	48.0	24.8	6.3	93.5
August . . . . .	5.0	5.8	42.3	32.4	11.5	95.0
September . . . . .	16.5	15.5	33.9	23.6	10.7	89.7

The distribution according to wind amount is almost identical with that for direction only. The percentages are somewhat greater in the former case for the predominant direction, *viz.*, south-west.

The following gives the distribution of winds according to direction for the retreating south-west monsoon period, October to December. It illustrates the change from predominant south-west to predominant north-east wind which occurs in October and November:—

Month.	PERCENTAGE NUMBER OF WINDS FROM						
	N. W. to N. E.	E.	S. E. to S. W.	W.	N. W. to E.	S. E. to W.	Calm.
October . . . . .	34.2	15.2	28.6	12.7	40.4	41.3	9.4
November . . . . .	51.5	20.3	12.8	3.6	80.3	16.4	2.0
December . . . . .	74.0	20.3	4.6	0.6	94.3	5.2	0.5

The table below gives similar data for the amount of wind according to direction:—

Month.	PERCENTAGE AMOUNT OF WIND FROM					
	N. W. to N. E.	E.	S. E. to S. W.	W.	N. W. to E.	S. E. to W.
October . . . . .	23.8	28.4	30.9	7.8	52.2	47.7
November . . . . .	40.7	43.5	14.3	1.6	84.2	15.9
December . . . . .	62.7	20.1	8.0	0.3	91.8	8.3

In the following table fuller details are given showing the change accompanying the retreat of the low pressure belt southwards down the Bay. It will be seen that the leading winds in October and November are from the east, and in December from the north-east:—

Month.	PERCENTAGE AMOUNT OF WIND FROM					
	N. W.	N.	N. E.	E.	S. E.	Other direction.
October . . . . .	8.2	4.7	10.9	28.4	19.5	28.3
November . . . . .	2.8	6.8	31.1	43.5	11.2	4.6
December . . . . .	4.6	17.8	40.3	29.1	7.0	21.2

The following brief summary of the wind distribution is of interest. It gives the percentage amount of wind from each of two ranges of direction, *viz.*, north-west to east and south-east to west, in each month of the year:—

Season.	Month.	DISTRIBUTION OF DIRECTION OF WIND ACCORDING TO MILEAGE.	
		N. W. to E.	S. E. to W.
Period of predominant north-east winds.	October . . .	52.2	47.7
	November . . .	84.2	15.9
	December . . .	91.8	8.3
	January . . .	98.8	1.2
	February . . .	95.1	4.9
	March . . .	93.9	6.2
Period of predominant south-west winds.	April . . .	70.1	30.0
	May . . .	35.5	64.5
	June . . .	13.5	86.5
	July . . .	9.7	90.3
	August . . .	14.4	85.6
	September . . .	20.1	80.1

The following gives data of the mean direction and steadiness of the winds as furnished by the anemographic and anemometric observations\* :—

Season.	Month.	WIND DIRECTION.		STEADINESS.	
		from anemograph data. (1)	from eye observations. (2)	(1)	(2)
Cool season . . .	January . . .	N 28° E	N 39° E	79	76
	February . . .	N 24° E	N 42° E	68	71
Premonsoon transition period.	March . . .	N 24° E	N 63° E	60	66
	April . . .	N 32° E	N 89° E	29	1
	May . . .	S 84° W	S 39° W	36	43
Rainy or south-west monsoon season.	June . . .	S 66° W	S 45° W	68	78
	July . . .	S 57° W	S 48° W	75	86
	August . . .	S 69° W	S 51° W	74	81
	September . . .	S 70° W	S 54° W	53	73
Post monsoon transition period.	October . . .	N 7° E	S 1° W	4	26
	November . . .	N 56° E	N 81° E	54	42
	December . . .	N 40° E	N 57° E	72	66

\* Very marked differences exist between the anemograph records and the eye observations owing partly to considerable differences of exposure and partly to the failure of the anemometer to record the direction of very light winds.—W. A. H.

*THE ANNUAL VARIATION OF THE AIR MOVEMENT (a)*—of the velocity as measured by the mean hourly air movement irrespective of direction:—

The following gives mean data of this element as obtained from the anemograph records and from observations of the anemometer.

SEASON.	MONTH.	MEAN HOURLY MOVEMENT IRRESPECTIVE OF DIRECTION.		Ratio (a) (b).
		Determined from anemographic observations (a).	Determined from anemometer observations (b).	
Cool season of north-east winds.	January	7.1	6.5	1.1
	February	6.2	5.0	1.2
	March	4.4	4.2	1.0
Transition period from N. E. to S.W. winds.	April	5.0	4.8	1.0
	May	5.5	7.4	0.7
	June	7.8	10.4	0.7
Rainy season of S. W. winds.	July	8.4	11.6	0.7
	August	7.8	10.8	0.7
	September	5.9	9.5	0.6
	October	6.5	6.3	1.0
Transition period from S.W. to N.E. winds.	November	9.7	6.7	1.4
	December	10.5	7.3	1.4

The comparison is interesting as showing the very large differences of the amount of wind recorded due to differences of exposure, and confirms the inference from similar comparisons in previous memoirs of the necessity for the wind observations being taken under absolutely the same conditions of exposure for the determination of the variations of the air movement from year to year. The anemometer, it will be seen, registered considerably larger amounts from May to September when winds were from the south-west monsoon directions, but less when winds were from north-easterly directions. The two instruments recorded practically equal amounts in the transition months of March, April and October. The ratio of the amounts for the months of the rainy season and May (the period of dominant S.W. winds) vary very slightly and average 0.7. For the period of north-east winds from November to February, the ratio averages 1.3, practically the inverse of the former ratio. The anemograph appears to have been most favourably situated for recording winds from the E.N.E. direction as indicated by the large value of the ratio for these months.

The anemometer data indicate that there is a double variation during the year, with two minima and maxima. The months of least air movement are March and October. These are included in the two transition periods, and exhibit transitional features in their most complete form, *viz.*, minimum air movement and great variability of movement (or minimum steadiness). The months of the greatest air movement are December and July. The former month exhibits the conditions most favourable for vigorous north-east winds, and the latter for south-west winds. The anemometer

observations indicate that the strongest winds occur in July, whereas those of the anemograph show the most vigorous movement in December.

A reference to the pressure and wind charts in the Meteorological Atlas of the Indian Seas gives the following variation of the 8 A.M. wind force (Beaufort scale) in the squares or areas to the east and west of the Andamans :—

Phase.	West of Andamans.		East of Andamans.	
	Wind Force.	Month.	Wind Force.	Month.
First minimum . . .	2.0	March . . .	2.3	{ March. April.
First maximum . . .	4.8	August . . .	4.1	{ June. July. August.
Second minimum . . .	2.8	October . . .	2.7	October.
Second maximum . . .	3.6	December . . .	3.6	December.

The results accord more closely with the anemometer than with the anemographic data at Port Blair.\* They indicate that winds are somewhat stronger in the more open sea to the west of the Andamans than they are to the east, and that they are absolutely feeblest in March and strongest about July. The secondary minimum is in October in both areas, and the secondary maximum in December.

The first minimum corresponds with the period of feeble gradients accompanying the establishment of local sea winds on the Bengal coast, and the second with the prevalence of uniform conditions of pressure over the Bay area during the period of withdrawal of the south-west monsoon currents from northern India. The first maximum corresponds with the greatest strength of the south-west monsoon circulation and the second with the strongest winds of the north-east monsoon.

(b) Annual variation of the velocity as measured by the north and east components of the mean daily air movement.

The following table gives the data :—

Month.	Mean north component in miles per diem.	Mean east component in miles per diem.	Resultant daily movement.	Percentage ratio of the resultant mean daily to the total or actual mean daily movement.	Direction of resultant daily movement.
January . . . . .	114	80	139	82	N. 35° E.
February . . . . .	88	67	110	74	N. 37° E.
March . . . . .	67	43	72	63	N. 37° E.
April . . . . .	15	46	48	40	N. 71° E.

\* Dallas's figures were obtained from the logs of ships covering the period 1893 to 1903. It seems therefore probable that the differences between the anemograph and anemometer were due rather to exposure and friction than to differences between the periods of observations.

Month.	Mean north component in miles per diem.	Mean east component in miles per diem.	Resultant daily movement.	Percentage ratio of the resultant mean daily to the total or actual mean daily movement.	Direction of resultant daily movement.
May . . . . .	—18	—40	44	33	S. 66° W.
June . . . . .	—68	—115	133	71	S. 59° W.
July . . . . .	—86	—122	149	74	S. 55° W.
August . . . . .	—56	—128	139	75	S. 67° W.
September . . . . .	—46	—63	78	55	S. 54° W.
October . . . . .	—22	50	54	35	S. 66° E.
November . . . . .	47	161	168	72	N. 74° E.
December . . . . .	110	149	185	74	N. 54° E.

The resultant air movement, like the actual air movement has two maxima and two minima in the course of the year. The absolute maximum is in December and the secondary maximum in July, and the minima are in May and October. The movement is least steady in May and October when the percentage ratios of the resultant to the total are 33 and 35 respectively. The percentage of steadiness for the period of strong north-east winds from November to February is 75 and of strong south-west winds from June to August 73.

*Annual and daily distribution of calms.*—The following table gives the percentage proportion of calms to the total number of wind observations for each month:—

Month.	Percentage of calms.
January . . . . .	3.1
February . . . . .	4.0
March . . . . .	6.9
April . . . . .	6.4
May . . . . .	2.9
June . . . . .	2.2
July . . . . .	0.5
August . . . . .	0.8
September . . . . .	4.7
October . . . . .	9.4
November . . . . .	2.9
December . . . . .	0.5

The data indicate that calms are least frequent in July and December, and most frequent in the transition months of October (9.4 per cent.) March and April (6.9 and 6.4 per cent. respectively).\*

\* It will be noticed that the months of maximum frequency of calms are those of minimum wind velocity as indicated by the anemometer; but the relation between wind velocity and proportion of calms is by no means exact, the anemograph indicated the minimum velocity in September (see page 154).

The following table gives the distribution of calms on the mean day of each of the months of maximum frequency, March, April and October :—

*Percentage number of calms at each hour of the day to total number of wind observation, at that hour.*

Hours.	March.	April.	October.
Midnight.	11	13	14
1	14	11	14
2	18	11	15
3	13	13	19
4	13	15	13
5	17	13	18
6	13	14	17
7	10	9	15
8	8	5	10
9	4	4	5
10	2	0	1
11	0	0	0
Noon	0	0	0
13	1	0	0
14	1	0	0
15	0	0	1
16	1	0	2
17	2	1	2
18	3	2	6
19	4	5	11
20	5	7	14
21	6	12	17
22	11	10	16
23	13	12	18

Calms hence vary only slightly in percentage amount from 10 P.M. to 7 A.M. They decrease rapidly in number between 8 A.M. and 10 A.M., are of rare occurrence from 10 A.M. to 5 P.M., and increase rapidly at about 8 P.M. These periods are related to other important features of the diurnal variation of the air movement, to be discussed later.



*Diurnal variation of the velocity or hourly amount of wind.* The north-east monsoon period.—The diurnal variation of this element is large and well marked. The following gives the chief features in this season :—

MONTH.	Maximum.	Minimum.	Amplitude.	Ratio to mean.	Epochs.	
					Maximum.	Minimum.
January . . . . .	8.2	6.0	2.2	0.3	1 P.M.	7 A.M.
February . . . . .	7.8	4.9	2.9	0.5	3 P.M.	5 A.M.

The curves representing the variation indicate much irregularity. The chief features are a single maximum at the hottest period of the day and a minimum in the early morning at about 5 A.M. The epochs correspond with the chief features of the temperature variation.

The curve for February when slightly smoothed is fairly regular and shows the most rapid variation in the morning hours from 9 A.M. to 10 A.M. The curve for January differs considerably from that of February in the afternoon and evening hours when the decrease is much smaller than in February, and the chief decrease occurs in the early morning instead of in the afternoon and evening.

*The pre-monsoon period, March to May.*—The diurnal variation is large and well-marked and the amplitude of change is almost as great as in the interior of India. The following gives data :—

MONTH.	Maximum.	Minimum.	Amplitude.	Ratio amplitude mean.	Epochs.	
					Maximum.	Minimum.
March . . . . .	7.7	2.5	5.2	1.0	3 P.M.	4 & 5 A.M.
April . . . . .	8.6	2.6	6.0	1.1	2 P.M.	4 A.M.
May . . . . .	8.4	3.8	4.6	0.8	1 P.M.	2 A.M.

The variation in March and April is of what may perhaps be termed the dry or continental type in which the amplitude is as large or larger than the mean.

The change of movement in March and April is greatest in the morning from 9 A.M. to 11 A.M. and in the afternoon from 5 P.M. to 7 P.M. The afternoon maximum rate of change is very slightly less than the morning, so that the day portion is very symmetrical with respect to the maximum. The following gives data :—

MONTH.	9-10 A.M.	10-11 A.M.	5-6 P.M.	6-7 P.M.
March . . . . .	1.0	1.2	1.0	1.0
April . . . . .	1.1	1.5	1.2	1.0

The night variation from 10 P.M. to 8 A.M. is small in total amount, more especially in March and May. In the former month the range of variation is only .5 and in May to 7 A.M. is only .4.

*June to September.*—The diurnal range is well-marked during this period, much more so than in north-east India. The following gives data :—

Month.	Maximum.	Minimum.	Amplitude.	Ratio amplitude mean.	Epochs.	
					Maximum.	Minimum.
June . . . . .	10.6	6.1	4.5	.5	1 P.M.	5 A.M.
July . . . . .	11.1	7.0	4.0	.4	1 P.M.	10 P.M.
August . . . . .	10.3	6.3	3.8	.5	Noon	10 P.M.
September . . . . .	9.0	4.2	4.5	.7	1 P.M.	12 P.M.

The epochs correspond to the epochs of temperature as in the preceding period, but the variation is, relatively to the maximum movement, much smaller and the curves for the day period are slightly less symmetrical. The morning rise is somewhat more rapid than the fall in the afternoon. The following gives data :—

Month.	Increase.	A. M.	Decrease.	P. M.
June . . . . .	1.3	9 to 10	1.1	6 to 7
July . . . . .	1.4	9 to 10	0.8	4 to 5
August . . . . .	1.4	9 to 10	0.9	5 to 6
September . . . . .	1.3	9 to 10	1.0	6 to 6

The variation as shown by the table below is slight from about 9 P.M. to 7 A.M.

Month.	Variation 9 P.M. to 7 A.M.
June . . . . .	0.5
July . . . . .	0.4
August . . . . .	0.6
September . . . . .	0.5

*October to December.*—The diurnal variation in November and December is more irregular than in the previous periods but the curves present a well-marked maximum and minimum. The amplitude decreases rapidly with the season as shown below :—

Month.	Maximum.	Minimum.	Amplitude.	Ratio.	Epochs.	
					Maximum.	Minimum.
October . . . . .	9.2	4.9	4.3	.6	1 P.M.	4 A.M.
November . . . . .	11.6	8.3	3.3	.3	1 P.M.	8 A.M.
December . . . . .	11.5	9.6	1.9	.2	Noon	3 A.M.

The most remarkable feature is the rapid decrease of the amplitude with increasing movement. The chief variation corresponds with the temperature variation. There

are slight irregularities in the evening hours, but it is doubtful whether these are not due to insufficient observations.

The maximum rate of increase is considerably greater than the maximum rate of decrease, as shown by the following table :—

Month.	Increase.	A.M.	Decrease.	P.M.
October . . . .	1.2	9 to 10	.7	4 to 5
November . . . .	0.8	9 to 10	.5	6 to 8
December . . . .	0.5	7 to 8	.4	1 to 2

*The year.*—The curve for the year is fairly regular and symmetrical, the maximum rate of increase being 1.1 from 9 to 10 A.M. and the maximum rate of decrease 0.6 from 6 to 7 P.M. The minimum velocity is 5.7 at 5 A.M. and the maximum 9.3 at 1 P.M.

*The diurnal rotation of the air movement.*—The data for this feature are given in tables 4 and 5 of the Appendix, and the illustration curves in plates XXXIII to XXXVII and XL and XLI.

*November to April.*—The curves are on the whole similar for each month of this period. The mean winds range between N. by W. and E. by S., but there is an additional movement from east from 10 A.M. to 8 P.M., the maximum of which varies to some extent. It occurs about noon in November and December, 1 P.M. in January and 3 P.M. to 4 P.M. from February to March. During the remainder of the day the diurnal rotation is due to a residual movement from approximately westerly directions, increasing in amount from 11 P.M. to about 7 A.M.

The diurnal rotation curves are elongated figures described in the positive direction or clockwise, the longest axis of which are in a direction approximately east and west, (most closely in March and April). The curves are small and somewhat irregular for November and December when the diurnal variation of the movement across the Madras coast is small and irregular. The temperature differences between the Peninsula and the Bay are then least, and the frequent rainfall introduces considerable irregularities into the air movement.

From January to April the variation of the wind off the Coromandel coast becomes more regular and marked, the chief feature being strong sea and land-breezes superimposed on the mean movement. The most important features of the diurnal rotation at Port Blair during this period are its magnitude and its large seasonal variation.

*May to October.*—The diurnal variation in May and October (and to a smaller extent in September) are transitional forms, and the curves are small and complex.

The curves for June, July and August all belong to the same type, in which the variation is chiefly in the direction of the mean wind or air movement, with a very slight transverse variation. The additional movement in the direction of the mean wind is positive from about 9 A.M. to 6 P.M. and hence corresponds with the general variation of the air movement over the whole Indian land area. The movement during the night hours from about 9 P.M. to 6 A.M. is constant except for a slight variation of direction due to small movements in the transverse direction (giving very slight additional westing to the winds from 9 P.M. to 4 A.M. and thence decreased westing until 9 A.M.).

The resolution of the diurnal rotation into a variation of the northerly and easterly components, exhibited by the curves for the four months, November, January, April and July, (Plate XLII) indicates its chief features from a somewhat different standpoint. The variation in the northerly direction in November and January is comparatively small, whilst that in the easterly direction is moderately large. The easterly component is positive during the day hours, and has a maximum shortly after noon. The curves for April, show that there is a large variation of the easterly component chiefly from 9 A.M. to 8 P.M., the maximum being at 2 P.M. to 3 P.M. There is also a moderate variation of the northerly component, chiefly during the day hours giving a maximum at 10 A.M. and a minimum about 4 P.M. The July resolution gives curves for the northerly and easterly components which are very similar and have their maximum and minimum epochs at the same periods of the day. This is in accordance with the inference from the diurnal rotation curve for the month, that the variation is chiefly one of varying strength of the movement in the mean wind direction.

*The year.*—The curve for the mean of the year is given in Plate XL, Fig. 1 and exhibits a diurnal rotation which is on the whole similar in character to that of the period from November to April, consisting chiefly of a variation in the easterly direction. As the rotation combines the features of two different types of variation, differing considerably in period, the curve is more complex than that of either type alone. It has two major loops which represent the changes during the periods 11 A.M. to 6 P.M. and 1 A.M. to 10 A.M. During the former period there is an additional easterly element which is a maximum from 1 P.M. to 2 P.M. and during the latter the easterly element is either in defect or there is superimposed on the mean movement a westerly component which is a maximum between 7 A.M. and 8 A.M. The resolution of the variation into northerly and easterly components is exhibited by the curves of Fig. 2 and Fig. 3 of the same plate.

*ANNUAL AND SEASONAL VARIABILITY OF THE AIR MOVEMENT.*—The following table gives a statement of the mean monthly velocity for each month of the period 1895-1904 at Port Blair.

Month.	MEAN AIR MOVEMENT PER DIEM.									
	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January . . .	164	208	169	219	189	116	119	98	166	189
February . . .	113	163	165	136	177	137	177	128	162	132
March . . .	121	116	121	91	113	122	126	45	99	96
April . . .	188	118	89	141	139	129	125	76	100	91
May . . .	179	138	106	128	152	116	113	105	133	126
June . . .	167	203	216	189	107	225	213	113	167	229
July . . .	217	216	197	168	193	223	197	203	181	185
August . . .	202	238	187	181	182	226	183	127	169	175
September . . .	151	158	170	122	147	161	113	128	137	...
October . . .	132	160	94	154	273	161	116	148	145	...
November . . .	235	211	270	210	188	202	287	187	217	...
December . . .	317	298	329	238	180	230	226	170	268	...
Mean of year . .	182	186	176	167	170	174	171	130	165	...

The following table gives summary of the preceding data arranged according to the four seasons :—

	North-east monsoon period.	Premonsoon period.	S. W. monsoon period.	Postmonsoon period.	Year.
1895 . . . . .	139	163	184	228	182
1896 . . . . .	185	124	212	214	186
1897 . . . . .	167	105	192	231	176
1898 . . . . .	178	119	165	210	167
1899 . . . . .	183	135	157	214	170
1900 . . . . .	142	122	209	199	174
1901 . . . . .	163	131	176	210	171
1902 . . . . .	113?	75?	150	168	130?
1903 . . . . .	164	111	161	220	165
1904 . . . . .	161	105	...	...	...
Mean . . . . .	156	119	179	210	169

The data for the first two seasons of the year 1902 are very doubtful judging simply from the smallness of the records. There is nothing in the curves or tabulated data to suggest that the instrument was not in full working order, and hence the means are given for the periods, as on the whole they probably represent real abnormal features of the air movement.

The following table gives extreme data :—

	MEAN MONTHLY AIR MOVEMENT PER DIEM.		Range.	Percentage ratio of range to mean daily movement.	Maximum amount in 24 hours.	Maximum amount in one hour.
	Maximum in period.	Minimum in period.				
January . . . . .	219	98	121	71	571	33
February . . . . .	177	113	64	43	532	33
March . . . . .	126	45	81	76	352	35
April . . . . .	188	76	112	93	518	38
May . . . . .	179	105	74	56	420	27
June . . . . .	229	107	122	65	390	28
July . . . . .	246	168	78	39	420	31
August . . . . .	238	127	111	50	390	29
September . . . . .	170	113	57	40	567	31
October . . . . .	273	94	179	115	772	43
November . . . . .	287	187	100	43	886	50
December . . . . .	329	170	159	63	837	46

The range of variation in the monthly means is greatest for the months of January, June, October and December.

The following table gives the frequency (in days per month) of the wind velocities indicated in miles per day at the heads of the columns:—

	Under 60.	60 to 100.	100 to 150.	150 to 200.	200 to 250.	250 to 300.	300 to 400.	400 to 500.	500 to 600.	600 to 700.	Over 700.
January . . . .	1.0	2.7	9.3	10.1	4.5	1.8	0.9	0.6	0.1	...	...
February . . . .	1.1	5.4	10.1	6.2	2.4	0.5	0.8	0.4	0.3	...	...
March . . . . .	2.7	11.7	13.3	1.9	0.3	0.2	0.1	...	...	...	...
April . . . . .	1.2	13.4	9.9	2.8	1.4	0.6	0.2	0.4	0.1	...	...
May . . . . .	0.4	10.6	11.0	4.9	2.1	1.0	0.7	0.1	...	...	...
June . . . . .	0.3	5.4	5.5	5.7	6.4	4.2	2.5	...	...	...	..
July . . . . .	0.1	1.3	6.8	7.6	8.0	4.4	2.2	0.2	...	...	...
August . . . . .	0.2	2.1	6.9	9.8	6.7	3.4	1.9	...	...	...	...
September . . . .	0.9	9.9	9.0	4.9	1.8	2.0	1.4	0.1	...	...	...
October . . . . .	3.7	11.5	5.1	3.1	2.4	1.3	1.3	1.2	0.9	0.1	0.3
November . . . .	0.9	5.8	5.2	3.1	3.8	2.8	3.9	1.7	1.3	0.3	0.4
December . . . .	0.1	1.8	5.2	5.9	6.7	3.3	3.8	1.7	0.7	0.8	0.4

The table illustrates some interesting features of the air movement at Port Blair. During the period from January to May, the daily amounts differ only to a moderate extent from the mean. Thus in January, for which the mean wind amount is 170 miles on 19.4 days of the month the amounts range between 100 and 200 miles, and in March the amounts range between 50 and 150 miles on 26.2 days, the mean wind amount being almost exactly 100 miles. Similar results hold for April, and May. In the period of humid winds from June to December the range of variation is much greater.<sup>1</sup>

Another interesting feature is the almost complete absence of strong winds exceeding 400 miles from June to September.\* During this period of four months the average duration of such winds is only 0.2 day. On the other hand they are of occasional occurrence from January to May (two days on the average) and of comparatively frequent occurrence from October to December (10.3 days). This confirms in the most striking manner the statement of the character of the winds in the Bay in the south-west monsoon proper, more especially the absence of cyclonic storm winds in the full sense of

\* Either the anemograph or the anemometer data are quite misleading in regard to this feature. The following has been made up from the tabulations of the 10 and 16 hour eye observations:—

Frequency in days per month of winds exceeding 400 miles per day, from anemometer observations:—

	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average.
January . . . .	0	0	0	0	0	2	0	0	0	0.2
July . . . . .	12	12	8	0	14	9	10	8	4	8.6
November . . . .	0	0	4	0	0	0	0	0	0	0.4

the word, and the large range of variation between the feeble winds and the strong winds of the alternating periods of the monsoon in the Bay.

#### METEOROLOGICAL OR STORM WINDS.

*Cold weather (January and February).*—Storms (in the proper sense of the word) very rarely if ever occur in the Bay or the Andaman Sea in January and February. Strong winds are occasionally experienced when steepish gradients normal in direction obtain as is frequently the case after the passage of cold weather storms through Bengal and Upper Burma. The high pressure conditions in Burma and Bengal are usually most marked when the storms give rain during their passage through these areas. Steep gradients also occasionally obtain during the rising phase of the short period oscillations of pressure which are a conspicuous and noteworthy feature in the meteorology of India, and are due to general actions undoubtedly extending over the whole of southern Asia and the Indian seas, and probably over a much larger area.

In the following are given hourly data of the air movement in two typical periods of strong winds at Port Blair during the cool season. The periods selected are :—

(a) The 12th and 13th of February 1897.

(b) The 27th to 29th of January 1898.

The general meteorological conditions are fully exhibited in the Daily Weather Reports and Charts of each period.

Weather was feebly unsettled in northern India on the 10th and 11th of February 1897 on which days light to moderate showers fell in north Bengal and Bihar and also in the Punjab. On the morning of the 12th, pressure was in considerable excess in north-east India and in moderate defect in the south of the Bay, and hence steeper gradients than usual obtained in the Bay area. Similar conditions slightly less marked continued on the 13th.

The second period of strong winds followed the passage of a feeble cold-weather disturbance across India. It gave numerous showers to the Punjab on the 23rd and 24th, a few local showers in the United Provinces on the 25th, and a series of thunderstorms with light to moderate rain to Bengal on the 26th. Pressure increased rapidly at the head of the Bay after the rainfall and was in considerable to large excess on the morning of the 27th, giving steep gradients over the Bay. Pressure gave way on the 29th and 30th and on the 31st normal gradients obtained.

FEBRUARY 1897.					JANUARY 1899.					
12th			13th		27th		28th		29th	
Hour.	Direction.	Amount during previous hour.	Direction.	Amount during previous hour.	Direction.	Amount during previous hour.	Direction.	Amount during previous hour.	Direction.	Amount during previous hour.
1	E.N.E.	13	N.E.	25	N.N.E.	8	E.N.E.	20	E.N.E.	19
2	"	12	"	25	N.E.	13	"	21	"	17
3	"	12	"	21	E.N.E.	20	"	24	N.E.	15
4	"	10	"	24	"	20	"	21	"	13
5	"	8	"	25	"	21	N.E.	15	"	11
6	E.	12	"	25	E.	25	E.N.E.	20	"	13
7	E.S.E.	30	"	28	"	25	"	20	"	12
8	"	20	"	28	"	28	"	24	"	14
9	"	24	"	29	"	19	"	23	"	13
10	E.	22	E.	22	"	16	"	26	"	12
11	"	20	"	33	"	21	"	25	"	11
12	"	27	E.S.E.	30	"	19	"	32	"	11
13	"	20	"	25	E.N.E.	15	"	28	"	11
14	"	22	"	23	"	15	"	31	"	11
15	"	21	"	20	E.	16	"	27	"	10
16	"	25	"	17	"	16	"	25	"	10
17	"	24	E.	15	"	15	"	26	"	10
18	"	21	"	13	E.N.E.	19	"	23	"	9
19	E.N.E.	20	E.N.E.	11	"	18	"	25	"	8
20	"	18	"	11	"	21	"	25	N.N.E.	8
21	"	20	N.E.	17	"	20	"	23	"	7
22	"	20	"	16	"	22	"	23	"	7
23	"	21	"	13	"	17	"	24	E.N.E.	9
24	N.E.	29	E.N.E.	12	"	19	"	20	"	10

The chief characteristics of these periods of strong winds are that they last for short periods of 24 to 72 hours, during which the accompanying easterly winds vary slightly in direction and intensity, and completely obscure the diurnal variation. Assuming that in such period the total amount of wind is not less than 300 miles in 24



hours, the following gives their number in each year of the period of anemographic observations:—

Month.	Year.	Period.	Number of days.	Amount in 24 hours.	Greatest in one hour.
January . . . . .	1896 . . . . .	1	1	379	26
	1897 . . . . .	1	1	338	20
	1898 . . . . .	3	7	571	33
	1899 . . . . .	1	2	364	22
	1903 . . . . .	1	3	446	24
	1904 . . . . .	2	2	451	30
February . . . . .	1897 . . . . .	1	2	508	33
	1899 . . . . .	1	4	532	30
	1901 . . . . .	3	4	441	37
	1902 . . . . .	1	4	413	28
	1903 . . . . .	1	1	303	20
	TOTAL . . . . .	16	31	...	...

The total number of periods in the nine years 1896-1904 was 16, and of days of strong winds 31, *i. e.*, an average of approximately two periods, and  $3\frac{1}{2}$  days per year.

#### PREMONSOON TRANSITION PERIOD.

As already pointed out, cyclonic storms occasionally form in this period in the neighbourhood of the Andamans, and march either westward to the Coromandel coast or northwards to the Bengal and Burma coast. Three such storms were generated during this season in the period 1895-1904. The conditions for their initiation are rarely present in March.

The following gives data of the occasions on which winds exceeding 300 miles in 24 hours were registered:—

Month.	Year.	Date.	Mean.	Maximum 24 hours.	Maximum in 1 hour.	REMARKS.
March . . . . .	...	...	No occasion.			Cyclonic storm. Ditto.
April . . . . .	1895.	22nd to 24th	490	548	32	
	1898	12th and 13th	473	486	38	
	1898	19th	315	315	28	
	1899	10th	321	321	24	
May . . . . .	1895	5th	340	340	20	Steep gradients for south-west winds in the Bay. Ditto.
	1895	17th	305	305	26	
	1895	19th	390	390	23	
	1899	26th and 27th	311	312	19	
	1903	18th	307	307	27	
	1904	23rd and 24th	403	420	26	

The following gives data of the winds during the storm of 22nd-26th April 1895 :—

Hour.	WIND DIRECTION.						WIND AMOUNT.					
	20th.	21st.	22nd.	23rd.	24th.	25th.	20th.	21st.	22nd.	23rd.	24th.	25th.
Midnight to 1 .	E.N.E.	E.	E.	S.S.E.	S.E.	S.S.W.	5	4	10	23	26	10
1 to 2 .	E.N.E.	E.	E.S.E.	S.E.	S.E.	S.W.	6	6	16	24	25	6
2 to 3 .	E.N.E.	E.S.E.	E.S.E.	E.S.E.	S.E.	S.S.W.	5	5	19	19	25	10
3 to 4 .	E.N.E.	E.S.E.	E.S.E.	E.S.E.	S.E.	S.S.W.	2	6	15	26	30	10
4 to 5 .	N.N.W.	E.S.E.	E.S.E.	E.S.E.	S.E.	S.	1	2	23	27	25	15
5 to 6 .	Calm	E.S.E.	E.S.E.	E.S.E.	S.E.	S.S.W.	0	3	19	30	29	11
6 to 7 .	Calm	E.	E.S.E.	E.S.E.	S.E.	S.S.W.	0	4	22	32	29	9
7 to 8 .	N.N.W.	E.N.E.	E.S.E.	S.E.	S.E.	S.	2	8	22	29	27	11
8 to 9 .	N.N.W.	E.N.E.	E.S.E.	S.E.	S.	S.S.W.	3	6	18	28	25	11
9 to 10 .	N.N.E.	N.E.	E.S.E.	S.E.	S.W.	Anemog.	5	9	24	25	11	...
10 to 11 .	N.E.	E.N.E.	E.S.E.	S.S.E.	S.	clock, stopped.	6	13	21	32	7	...
11 to 12 .	N.E.	E.N.E.	E.S.E.	S.S.E.	S.S.W.	...	7	12	17	24	11	...
12 to 13 .	N.E.	E.N.E.	E.S.E.	S.S.E.	S.S.W.	...	8	13	24	21	4	...
13 to 14 .	E.N.E.	E.N.E.	E.S.E.	S.E.	S.	...	8	13	22	24	5	...
14 to 15 .	E.N.E.	E.N.E.	E.S.E.	S.S.E.	S.S.E.	...	8	19	23	22	20	...
15 to 16 .	E.N.E.	E.	E.S.E.	S.S.E.	S.S.E.	...	9	13	25	23	21	...
16 to 17 .	E.N.E.	E.	E.S.E.	S.S.E.	S.S.E.	W.	9	19	19	20	24	9
17 to 18 .	E.N.E.	E.S.E.	E.S.E.	S.S.E.	S.S.E.	W.S.W.	8	16	21	25	20	9
18 to 19 .	E.N.E.	E.S.E.	E.S.E.	S.S.E.	S.S.E.	W.S.W.	10	21	19	27	11	5
19 to 20 .	E.N.E.	E.S.E.	S.E.	S.S.E.	S.S.W.	S.W.	9	14	23	19	9	4
20 to 21 .	E.N.E.	S.E.	S.E.	W.S.W.	S.	W.S.W.	9	25	22	4	11	4
21 to 22 .	E.N.E.	E.S.E.	E.	S.S.W.	S.S.W.	S.W.	5	13	17	10	10	4
22 to 23 .	E.N.E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	6	2	26	12	15	6
23 to 24 midnight	E.N.E.	E.	S.S.E.	S.S.E.	S.	S.S.W.	6	6	24	22	12	6

Other typical storms of this period were those of the 12th to 13th April 1898, and 23rd to 24th May 1904.

#### SOUTH-WEST MONSOON PERIOD.

Below are given data of typical cyclonic storms of this period. Further details may be found in the Meteorological Atlas of the Indian seas and in the annual summaries of the years concerned.

## CYCLONIC STORM, AUGUST 15TH TO 21ST 1900.

(See page 877, *Annual Summary*.)

Date.	Total.	Max.	Time.	Min.	Time.	N.N.W.	N.W.	W.N.W.	W.	W.S.W.	S.W.	S.S.W.	S.
12	199	11	13 to 14	6	6 to 7 21 to 22	...	...	3	10	11	...	...	...
13	225	13	13 to 14	7	19 to 20	2	1	18	3	...	...	...	...
14	245	14	13 to 15	8	2 to 3 10 to 11	...	8	16	...	...	...	...	...
15	272	18	14 to 15	6	8 to 9	...	5	18	1	...	...	...	...
16	337	19	14 to 15	11	19 to 21	...	...	4	20	...	...	...	...
17	317	21	14 to 15	9	18 to 19	...	...	3	21	...	...	...	...
18	306	20	13 to 14	8	5 to 6 20 to 21	...	...	1	21	2	...	...	...
19	221	13	9 to 10 12 to 13	5	19 to 20	...	7	15	12	...	...	...	...
TOTAL						2	21	78	88	13	...	...	...

## CYCLONIC STORM, SEPTEMBER 1899.

(See page 720, *Annual Summary*.)

Date.	Total.	Max.	Time.	Min.	Time.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W.
19	176	13	15 to 16	3	17 to 18	...	10	10	3	1	...
20	319	20	10 to 11 12 to 13	8	7 to 8	...	21	1	1	1	...
21	316	22	7 to 8	9	20 to 21	...	17	7	...	...	...
22	311	19	10 to 11 13 to 14	4	19 to 20	...	21	2	1	...	...
23	201	12	11 to 12	4	4 to 5	4	12	6	2	...	...
TOTAL						4	81	26	7	2	...

The chief feature is the steady but intensified monsoon winds.

## CYCLONIC STORM OF JULY 26TH TO 30TH, 1896.

(See page 635, Annual Summary).

Maximum.	Direction.	Date.	Total.	E.	S. E. W.	S. W.	W. S. W.	W.	W. N. W.	N. W.	N. N. W.
15	4	July 19th	199	5	1	8	5	3	2	2	...
15	8	" 20th	264	...	...	...	16	5	3	...	...
18	11	" 21st	359	...	...	...	21	...	...	...	...
24	10	" 22d	358	...	...	...	20	...	1	3	...
20	11	" 23d	372	...	...	14	10	...	...	...	...
20	10	" 24th	370	...	...	13	8	2	1	...	...
19	9	" 25th	351	...	...	6	17	1	...	...	...
25	14	" 26th	420	...	...	19	5	...	...	...	...
20	12	" 27th	405	...	...	24	...	...	...	...	...
21	8	" 28th	384	...	...	18	2	...	1	3	...
21	10	" 29th	347	...	...	22	2	...	...	...	...
19	10	" 30th	316	...	...	21	...	...	...	...	...
19	5	" 31st	302	1	5	17	1	...	...	...	...
25	5	August 1st	327	1	6	16	1	...	...	...	...
20	5	" 2d	291	...	4	15	...	...	1	...	1
11	4	" 3d	179	...	2	9	3	4	5	1	...

*Amount of wind, July 1896.\**

HOURS.	21st.	22nd.	23rd.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Mean of period.
0 to 1	11	11	17	15	10	18	16	15	15	11	13	14
1 to 2	15	14	14	15	15	14	10	15	18	10	10	14
2 to 3	14	15	15	15	14	17	15	18	10	11	10	14
3 to 4	14	15	11	15	16	16	15	17	15	14	15	15
4 to 5	12	15	15	15	10	20	20	15	15	10	12	14
5 to 6	14	14	15	13	9	20	15	20	14	11	13	14
6 to 7	15	14	12	15	14	15	16	18	13	11	10	14
7 to 8	11	15	17	14	15	25	19	15	15	17	13	16
8 to 9	14	12	11	18	14	15	13	14	18	12	10	14
9 to 10	15	18	15	15	16	16	17	12	16	19	12	16
10 to 11	13	13	15	20	14	19	13	21	21	12	16	17
11 to noon	17	18	17	15	18	21	17	17	15	14	19	17
Noon to 13	18	16	20	20	15	19	20	20	17	14	16	18
13 to 14	16	13	14	20	16	20	15	13	16	13	14	17
14 to 15	16	13	19	20	19	20	17	12	15	15	18	17
15 to 16	15	24	19	20	19	20	16	12	12	17	12	17
16 to 17	15	15	16	15	12	20	17	11	15	11	13	15
17 to 18	15	13	12	12	16	14	16	12	13	12	14	14
18 to 19	15	18	16	10	16	15	13	8	12	13	13	14
19 to 20	14	14	17	14	17	17	12	12	13	11	13	14
20 to 21	16	13	20	12	11	14	16	15	15	10	12	14
21 to 22	17	12	15	14	12	15	17	13	10	11	12	14
22 to 23	13	10	15	15	18	15	16	14	10	14	5	13
23 to 24	15	13	15	13	15	15	20	15	14	12	8	14

## POST-MONSOON PERIOD.

There is an almost entire absence of cyclonic storm winds in the centre of the Bay from June to September. From October to December cyclonic storms occasionally form in the centre and south of the Bay (apparently over the area of re-curvature of the south-west current) so that Port Blair is either to the east or north-east of the storm area, even in its initial stages. The storms almost invariably march westwards, and Port Blair experiences winds of increasing intensity during the earlier stages of development of the storms, and strong but decreasing winds with their westward march to the Coromandel or Circars coasts.

Assuming that disturbed weather is associated with winds of over 400 miles per diem for at least 48 hours and a maximum of 25 miles in one hour, the following gives data of all such periods in 1894 to 1904 :—

\*NOTE :—(1) The remarkable steadiness of the winds throughout.

(2) The smallness of the diurnal variation, and its approximate accordance with the mean diurnal variation of the period.

Month.	Year.	Date.	Mean 24 hours.	Maximum in 24 hours.	Maximum in one hour.	Direction of maximum.	Occasion.	
October .	1894	18th to 22nd .	583	730	40	E.	Cyclonic storm crossed Madras coast on 22nd.	
		29th to 31st .	428	438	33	S. E.	Ditto.	
	1895	23rd .	514	514	28	"	Crossed Circars coast.	
	1898	9th to 11th .	426	519	91	E. S. E.	Feeble storm crossed Circars coast.	
		23rd .	423	423	26	E.		
	1899	10th and 11th .	444	445	30	E. S. E.	Moderate storm Coromandel coast.	
		20th and 21st .	465	488	29	E. N. E.		
	1900	24th to 29th .	556	705	40	S. S. E.		
		22nd and 23rd .	480	518	37	E. S. E.		
	1902	26th and 27th .	481	484	30	E.		
	1903	27th and 28th .	603	772	43	E. S. E.		
	November	1894	12th and 13th .	483	507	32	"	No storm shown by D. W. R., apparently effect of steep gradients.
			23rd .	563	563	30	E.	
1895		20th to 23rd .	476	521	28	E. N. E.		
1896		9th to 12th .	426	481	47	E. S. E.		
		17th to 19th .	467	529	31	E.		
1897		24th to 30th .	683	886	50	"		
1898		2nd to 5th .	512	590	39	E. S. E.		
		23rd and 24th .	487	636	28	E. N. E.		
1899		27th and 28th .	525	585	34	N. E.		
1900		2nd .	564	564	30	W. S. W.		
1901		21st to 24th .	540	702	36	E.		
		11th .	411	411	25	"		
		18th and 14th .	419	431	28	E. S. E.		
1903		11th .	546	546	38	E. N. E.		
		3rd .	501	501	30	E. S. E.		
		23rd to 27th .	522	670	35	"		
December		1894	12th to 15th .	Data im- perfect.	648	46	"	Steep gradients in south of Bay.
			19th and 20th .	445	448	28	E.	
		1895	8th to 11th .	731	887	41	E. S. E.	
	13th .		453	453	24	"		
	1896	5th to 7th .	506	513	30	E.		
	1897	1st .	457	457	39	E. N. E.	Steep gradients in south of Bay.	
23rd to 28th .		593	727	41	E. S. E.	Ditto.		
	1898	6th .	583	583	30	E.	Steep gradients in S. E. of Bay.	
		15th and 16th .	Data imperfect.	36	E. N. E.			
	1900	15th to 17th .	598	653	35	E. S. E.		
	1901	4th to 7th .	616	816	40	N. E.		
	1903	1st to 4th .	472	486	30	S. E.		
27th .		458	458	25	N.			

The following gives a summary:—

Month.	Number of periods.	Number of days.	Maximum in 24 hours.	Maximum in 1 hour.
October . . . . .	11	20	772	43
November . . . . .	16	44	886	50
December . . . . .	13	36	887	46

And according to years:—

Year.	NUMBER OF STORM PERIODS.			Total.	Number of days.
	October.	November.	December.		
1894 . . . . .	2	2	2	6	17
1895 . . . . .	1	1	2	4	10
1896 . . . . .	...	2	1	3	10
1897 . . . . .	...	1	2	3	14
1898 . . . . .	2	2	2	6	13
1899 . . . . .	3	1	...	4	12
1900 . . . . .	1	1	1	3	6
1901 . . . . .	...	3	1	4	11
1902 . . . . .	1	...	...	1	2
1903 . . . . .	1	3	2	6	14

The above indicates that the average number of storms in this season is 3·3 per year, and of stormy days 10·1, i.e., three days for each storm.

The following gives mean data for:—

1903 October 27th and 28th.

1897 November 26th to 30th.

1895 December 9th to 11th.

	1903 October.	1897 November.	1895 December.
	27th to 28th.	26th to 30th.	9th to 11th. (6 P.M., 8th to 6 P.M., 11th).
Midnight to 1 . . . . .	31.0	34.8	30.6
1 to 2 . . . . .	34.0	32.2	35.0
3 . . . . .	27.0	28.4	32.6
4 . . . . .	29.0	32.2	36.3
5 . . . . .	29.0	30.2	32.6
6 . . . . .	28.5	31.2	33.3
7 . . . . .	32.5	32.8	36.6
8 . . . . .	30.0	29.6	38.0
9 . . . . .	27.0	26.6	33.7
10 . . . . .	26.5	27.2	32.7
11 . . . . .	31.0	31.0	35.0
12 . . . . .	25.5	35.4	35.0
13 . . . . .	20.5	33.8	33.7
14 . . . . .	17.5	32.0	33.0
15 . . . . .	26.0	31.4	31.6
16 . . . . .	25.5	33.0	32.6
17 . . . . .	28.0	34.0	33.0
18 . . . . .	24.0	33.4	34.7
19 . . . . .	18.0	30.2	32.3
20 . . . . .	17.0	31.4	30.0
21 . . . . .	17.5	32.4	29.7
22 . . . . .	22.5	30.4	27.0
23 . . . . .	12.5	29.6	29.3
24 . . . . .	19.5	31.4	29.0





TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

March.										April.									
Hr.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Cal.	Hr.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Cal.
0	101	51	56	6	0	3	6	55	31	29	39	41	15	15	27	53	37		
1	97	47	52	7	0	2	6	62	41	34	34	41	17	14	25	59	32		
2	94	37	47	6	1	2	6	79	51	57	39	36	17	15	26	66	31		
3	101	32	24	6	1	2	7	79	39	55	32	33	17	9	25	63	33		
4	100	33	22	6	0	2	10	60	34	52	29	24	18	6	25	72	42		
5	91	25	15	5	1	2	11	85	48	55	23	28	16	7	29	89	38		
6	93	28	14	6	1	2	9	69	35	37	27	27	14	7	27	81	39		
7	100	24	11	5	1	1	10	107	24	61	22	23	14	6	29	65	26		
8	95	31	13	5	0	1	10	109	24	71	27	29	14	7	28	89	15		
9	107	55	13	4	1	1	9	57	11	74	69	29	14	9	34	77	11		
10	117	103	18	3	1	0	6	41	6	72	53	40	19	6	21	43	1		
11	89	155	27	3	1	0	2	18	1	35	112	67	26	10	5	17	23	1	
Mean	93	164	54	3	1	0	2	7	0	21	102	56	33	10	7	14	20	1	
12	52	158	72	9	1	0	2	3	2	17	95	94	35	12	9	13	21	0	
13	44	150	64	13	1	2	0	3	3	15	73	105	46	14	8	11	24	0	
14	35	127	105	29	0	1	2	4	0	16	63	104	69	17	9	9	31	0	
15	35	115	112	22	2	2	2	6	2	18	49	85	59	20	11	14	32	0	
16	35	110	105	25	2	2	3	11	4	16	46	99	57	18	7	24	36	2	
17	39	103	69	23	2	4	8	10	8	19	44	82	54	20	9	21	40	5	
18	53	93	34	19	2	4	5	18	12	22	45	71	40	25	11	23	44	13	
19	61	92	69	12	1	2	9	26	15	23	46	67	33	23	16	21	46	21	
20	74	74	53	11	2	1	7	48	18	26	44	58	27	16	16	24	50	34	
21	103	54	40	6	0	2	3	49	32	57	39	48	20	11	11	19	54	31	
22	102	55	39	8	1	0	6	46	38	53	38	44	29	14	12	22	52	35	
Total	1,593	1,920	1,151	233	23	35	144	1,134	459	Total	929	1,171	1,353	687	307	270	528	1,237	453
Per cent.	259	272	168	33	63	65	20	161	69	Per cent.	142	167	194	98	14	38	75	178	64

TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

MAX.										JAN.									
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.	Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.
0	26	12	13	14	30	68	63	63	14	0	6	1	2	1	33	124	83	33	13
1	32	10	14	14	26	74	57	59	16	1	8	1	3	1	31	114	92	39	9
2	33	8	12	14	30	73	61	59	13	2	7	1	3	3	26	116	88	43	12
3	33	11	10	15	32	67	63	58	15	3	7	2	3	3	28	108	86	48	14
4	31	7	9	17	30	72	61	59	18	4	7	2	3	3	30	109	90	45	10
5	27	7	11	15	26	62	64	66	24	5	8	2	3	2	33	111	83	42	14
6	30	6	11	18	27	58	63	70	17	6	9	2	1	1	31	112	80	45	15
7	29	6	11	16	31	63	62	72	11	7	9	1	2	2	34	113	81	41	15
8	31	11	7	16	33	60	69	70	7	8	9	1	2	3	37	118	79	38	10
9	33	12	12	17	32	57	70	64	6	9	7	1	2	5	40	119	81	40	2
10	35	15	15	28	32	59	58	58	2	10	12	2	1	9	35	113	87	36	0
11	28	20	27	35	32	57	59	42	2	11	7	1	2	16	35	115	81	41	0
Noon	23	19	30	37	32	57	62	42	0	Noon	8	1	3	16	35	115	81	36	2
13	20	14	33	40	28	57	59	50	1	13	7	2	3	17	32	120	79	37	1
14	24	11	32	33	29	57	62	57	0	14	8	2	3	19	30	121	76	39	0
15	21	14	25	35	29	55	69	57	0	15	7	2	3	16	30	116	82	42	1
16	22	15	21	30	34	52	65	64	2	16	7	3	2	13	32	119	82	39	0
17	22	16	22	17	35	60	69	58	4	17	7	3	3	7	32	115	84	44	2
18	22	14	24	19	32	70	63	60	1	18	4	2	4	6	32	120	86	39	2
19	18	16	20	22	26	64	66	65	7	19	4	3	4	3	32	129	83	33	3
20	19	14	18	16	34	60	70	67	5	20	7	2	3	2	36	121	87	32	6
21	34	12	14	13	30	63	62	61	15	21	7	2	2	1	36	115	87	35	11
22	27	13	18	16	33	61	62	65	8	22	15	1	2	0	30	112	93	38	7
23	30	9	14	15	31	65	61	59	19	23	9	1	2	1	34	128	80	33	9
Total	650	292	423	512	734	1,401	1,520	1,445	207	Total	186	41	61	150	784	2,803	2,011	988	158
Per cent.	9.0	4.0	5.8	7.0	10.1	20.5	20.9	19.9	2.9	Per cent.	2.6	0.6	0.9	2.1	11.0	30.3	28.2	19.2	2.2

TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

JAN.										AUGUST.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	6	2	1	3	34	158	76	21	4	0	0	0	2	2	30	139	91	34	0
1	5	2	2	5	33	153	82	21	2	1	8	1	0	3	27	136	101	31	3
2	4	2	1	0	32	153	85	20	2	2	0	0	0	3	27	135	90	37	3
3	3	2	2	3	32	154	82	23	4	3	0	0	1	3	26	131	105	36	2
4	6	2	1	3	33	153	82	22	4	4	5	0	1	3	25	133	95	42	5
5	6	3	1	2	31	155	85	19	3	5	4	1	0	1	25	129	104	40	5
6	6	2	2	2	37	155	79	18	4	0	7	1	0	2	25	132	106	33	4
7	4	2	2	3	42	148	83	19	2	7	8	1	0	2	24	135	106	33	1
8	5	2	1	5	41	148	81	22	0	8	3	1	0	4	27	130	102	43	0
9	4	2	0	6	47	142	81	22	0	9	6	1	0	4	28	126	100	45	0
10	8	3	1	0	41	143	74	20	0	10	11	0	2	6	27	115	101	47	0
11	8	2	2	11	37	134	88	23	0	11	11	0	2	7	25	115	101	48	0
Noon	6	3	2	14	35	136	87	22	0	Noon	12	0	1	8	23	112	99	53	1
13	8	5	3	12	40	133	84	20	0	13	13	1	0	7	25	106	107	50	1
14	8	5	2	13	38	139	79	21	0	14	10	1	1	5	23	114	112	43	1
15	7	4	2	13	36	140	79	24	0	15	11	1	1	6	21	109	111	50	0
16	4	4	4	11	35	146	78	22	1	16	9	1	0	5	21	122	105	47	0
17.	7	4	2	8	38	146	78	22	0	17	9	1	0	3	22	116	118	40	1
18	6	4	2	6	30	150	76	23	0	18	10	2	0	4	24	135	99	34	1
19	4	5	2	6	36	149	82	21	0	19	9	1	1	3	27	132	99	33	4
20	3	5	2	5	35	156	79	19	1	20	6	2	1	3	29	137	97	30	4
21	3	4	2	6	40	158	76	15	1	21	6	1	2	2	31	137	92	33	5
22	8	3	1	4	38	142	80	27	1	22	12	0	1	3	20	135	94	34	4
23	6	2	1	4	37	140	82	23	4	23	6	0	1	3	24	141	88	42	5
Total	135	74	41	100	880	3,637	1,938	514	33	Total	194	17	17	92	612	3,052	2,432	958	56
Per cent.	1.9	1.0	0.6	2.2	12.1	48.3	26.5	7.0	0.5	Per cent.	2.6	0.2	0.2	1.2	8.2	41.1	32.8	12.9	0.8

TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

SARRESEN.										OCEANUM.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	19	4	4	5	33	95	73	33	30	0	31	21	37	26	26	30	32	30	38
1	10	4	5	4	36	97	77	34	22	1	29	20	31	32	26	30	33	41	38
2	16	3	7	5	32	101	80	35	19	2	30	21	33	28	22	28	35	41	42
3	16	4	6	5	31	97	70	42	27	3	26	23	33	26	20	28	30	42	52
4	15	4	6	7	31	90	87	33	25	4	36	19	29	27	21	25	35	53	35
5	14	6	6	6	31	96	79	40	20	5	31	18	30	25	18	23	42	42	51
6	16	5	6	7	29	91	79	37	28	6	28	20	30	25	22	20	40	47	48
7	14	5	3	9	35	85	78	43	27	7	31	20	34	24	20	24	36	49	42
8	14	5	4	7	42	90	78	45	13	8	28	22	34	25	28	26	44	46	27
9	12	7	6	11	41	91	79	43	6	9	30	28	39	27	27	23	39	54	14
10	15	10	7	19	35	80	81	50	0	10	33	49	41	33	26	24	33	40	2
11	14	9	9	25	43	71	80	46	0	11	32	47	48	38	23	25	37	32	1
Noon	10	11	13	27	45	74	72	46	0	Noon	25	50	52	39	28	31	33	23	1
13	8	8	18	25	40	76	81	42	0	13	20	44	56	45	28	31	34	26	0
14	8	8	17	24	36	77	80	48	0	14	20	39	59	45	23	27	37	32	0
15	16	7	12	24	31	72	83	51	2	15	19	37	55	42	25	25	31	40	2
16	16	8	12	20	33	74	84	51	0	16	18	35	51	40	27	21	37	45	4
17	17	7	11	12	28	82	85	53	3	17	21	29	52	32	25	20	41	51	6
18	16	8	10	10	33	73	91	50	7	18	16	31	50	30	24	29	33	47	17
19	14	6	7	9	33	78	93	41	14	19	15	28	47	26	21	29	35	46	30
20	18	5	8	8	31	94	82	42	14	20	19	21	45	26	16	28	41	43	37
21	10	5	6	9	36	89	71	41	27	21	16	21	43	28	20	25	36	40	48
22	25	4	7	9	34	92	61	42	22	22	34	21	43	28	15	26	28	38	46
23	18	3	6	7	33	92	70	38	31	23	28	10	40	27	22	26	28	38	51
Total	355	146	106	291	832	2,037	1,897	1,029	337	Total	616	683	1,012	744	551	924	853	995	632
Per cent.	50	20	27	41	11.6	28.8	26.6	14.4	4.7	Per cent.	9.2	10.2	15.2	11.1	8.2	9.3	12.7	14.8	9.4

TABLE I.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—concluded.

NOVEMBER.										DECEMBER.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	47	78	84	18	7	7	7	23	15	0	70	122	65	9	3	0	1	23	4
1	45	73	79	19	8	9	8	25	19	1	73	119	65	7	2	2	1	25	3
2	48	73	74	21	7	8	12	24	15	2	72	118	59	10	2	3	1	32	1
3	45	71	71	21	5	11	13	29	16	3	72	112	62	9	3	0	1	33	6
4	47	67	73	23	5	7	16	29	15	4	67	117	58	9	3	1	1	37	4
5	51	63	74	19	5	5	16	33	14	5	75	113	56	9	2	1	1	37	3
6	49	68	69	18	7	6	14	39	9	6	79	110	55	10	2	1	2	34	3
7	50	69	66	19	7	6	14	38	13	7	81	110	54	11	2	1	2	36	1
8	50	76	66	22	7	5	14	40	6	8	79	111	58	12	1	0	2	34	1
9	47	85	71	21	7	6	13	38	0	9	75	118	56	11	2	0	3	30	0
10	46	104	74	18	9	5	10	24	1	10	80	124	57	13	1	0	2	21	1
11	41	105	89	23	6	7	5	15	0	11	73	129	60	15	2	0	1	19	0
Noon	25	106	104	31	6	7	4	10	0	Noon	69	135	64	12	2	0	1	17	0
13	25	96	104	32	9	8	6	10	1	13	70	128	68	13	2	0	2	17	0
14	28	100	101	29	6	5	9	11	0	14	67	131	67	13	3	0	2	18	0
15	24	100	101	29	7	7	8	17	0	15	66	133	68	11	3	1	3	15	0
16	25	95	103	28	5	9	10	18	1	16	63	138	66	11	3	0	3	15	0
17	26	93	103	28	8	7	9	19	1	17	67	138	63	13	3	1	2	14	0
18	28	92	96	26	9	9	8	21	5	18	67	138	63	10	3	0	2	16	1
19	33	93	88	25	7	5	12	23	5	19	71	136	60	10	2	0	3	16	1
20	31	91	82	22	9	8	12	23	12	20	70	135	59	10	3	1	2	18	1
21	30	92	84	21	8	8	11	21	14	21	71	133	60	9	3	1	1	20	1
22	46	85	82	19	6	5	10	21	14	22	76	125	60	10	2	1	1	21	1
23	43	79	84	19	6	6	7	21	22	23	71	125	63	8	3	3	0	23	2
Total	930	2,054	2,022	551	168	166	248	572	198	Total	1,754	2,998	1,466	255	57	17	40	571	34
Per cent.	13.5	29.7	28.3	8.0	2.4	2.4	3.6	8.3	2.9	Per cent.	24.1	41.9	20.3	3.6	0.8	0.2	0.6	8.0	0.5

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years.

FEBRUARY.										
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.		
0	785	968	345	29	0	0	0	54	0	444
1	792	877	341	33	0	0	1	55	1	454
2	700	859	355	27	0	0	2	92	2	410
3	660	827	344	36	0	0	1	107	3	364
4	652	778	321	23	0	0	2	107	4	386
5	666	760	283	22	0	0	4	109	5	382
6	653	748	311	12	0	0	3	131	6	406
7	668	749	274	15	0	0	3	128	7	408
8	748	799	302	20	0	0	2	128	8	428
9	751	835	329	19	0	0	2	144	9	475
10	789	1,046	350	28	0	0	1	69	10	564
11	751	1,167	402	16	0	0	0	46	11	545
Noon	723	1,300	443	15	0	0	0	25	Noon	503
13	722	1,313	445	22	0	0	0	9	13	456
14	648	1,362	406	17	0	0	0	22	14	407
15	640	1,247	394	37	0	0	0	27	15	403
16	660	1,182	418	43	0	0	0	41	16	382
17	692	1,103	380	42	0	0	0	49	17	424
18	763	1,028	371	40	0	0	0	61	18	428
19	750	962	417	10	0	0	0	128	19	466
20	810	949	387	26	0	0	0	105	20	454
21	826	932	370	21	0	0	0	82	21	495
22	828	1,021	351	15	0	0	0	67	22	508
23	806	950	333	37	0	0	0	59	23	483
Total	17,400	23,691	8,672	605	0	0	21	1,845	Total	10,677
Per cent.	33.4	45.3	16.6	1.2	0	0	0	3.5	Per cent.	26.3

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

APRIL.																	
Hour.	MAJOR.								Hour.	MINOR.							
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
0	236	215	152	14	1	4	14	118	0	133	192	267	93	74	43	62	146
1	304	203	143	17	0	6	13	137	1	131	178	281	101	48	65	47	124
2	290	140	137	20	1	7	14	158	2	130	143	251	103	21	45	51	137
3	286	141	99	22	1	6	21	180	3	115	148	210	108	27	50	45	123
4	285	133	70	17	0	4	27	197	4	108	115	180	105	14	54	58	140
5	259	121	65	17	1	7	30	225	5	120	98	189	103	22	29	76	177
6	237	118	61	20	1	6	26	257	6	132	102	148	106	22	45	65	192
7	297	116	40	17	2	4	22	283	7	139	103	194	119	34	36	85	220
8	302	142	47	10	0	4	25	306	8	189	146	188	123	35	34	102	251
9	384	265	66	13	2	4	21	237	9	234	209	193	127	79	29	155	302
10	494	531	98	15	3	1	20	140	10	292	423	316	209	42	46	101	207
11	478	888	177	24	2	0	9	85	11	180	704	528	301	83	36	103	137
Noon	397	987	364	21	1	2	7	41	Noon	152	699	709	331	99	58	87	146
13	333	1,058	569	79	1	3	8	24	13	103	697	829	417	123	61	96	149
14	294	1,012	732	123	4	11	3	21	14	103	590	962	481	105	55	79	179
15	233	955	857	175	0	6	14	32	15	69	474	949	606	146	49	50	208
16	244	873	828	173	11	15	12	39	16	94	380	821	551	186	58	58	212
17	247	779	750	180	3	14	19	58	17	83	329	758	477	181	38	125	206
18	231	658	593	126	10	17	33	62	18	80	290	560	394	175	47	100	191
19	278	543	389	72	5	15	34	94	19	75	289	414	249	166	47	91	201
20	308	452	291	34	2	7	37	161	20	75	240	334	170	103	61	60	175
21	304	362	229	17	6	4	26	217	21	88	237	289	150	76	56	59	163
22	369	264	163	14	0	4	9	175	22	163	217	322	79	53	40	48	160
23	332	248	156	18	2	1	16	119	23	151	192	301	117	61	34	49	129
Total	7,502	11,204	7,076	1,238	62	162	460	3,375	Total	3,158	7,185	10,193	5,635	1,980	1,121	1,874	4,284
Per cent.	24.1	36.1	22.8	4.0	0.2	0.5	1.5	10.9	Per cent.	8.9	20.3	28.8	15.9	5.6	3.2	5.3	12.1



TABLE 2.—Number of miles recorded under each point of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

JUNE.																	
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
0	63	47	85	83	141	333	250	208	0	40	11	13	2	221	954	512	164
1	97	39	72	95	133	365	242	195	1	40	10	20	2	171	881	584	187
2	75	40	53	75	129	357	267	160	2	41	9	18	12	166	866	561	225
3	78	35	54	84	120	365	262	162	3	48	17	20	14	198	806	550	230
4	83	23	36	92	145	368	261	194	4	39	15	14	11	207	840	551	210
5	69	42	52	93	118	355	248	249	5	51	12	9	5	215	831	482	208
6	101	32	52	99	113	338	245	253	6	45	10	3	12	225	847	511	211
7	97	40	57	91	157	343	266	268	7	52	9	6	15	236	911	508	191
8	131	79	26	104	173	373	323	257	8	51	7	18	25	294	977	512	196
9	149	78	69	118	238	412	320	275	9	36	5	18	66	355	1,042	558	223
10	202	89	121	226	290	469	360	347	10	53	13	20	126	366	1,161	676	235
11	180	148	215	346	331	496	377	280	11	52	7	17	213	439	1,260	673	293
Noon	167	150	287	365	297	537	415	315	Noon	76	13	21	218	429	1,367	728	292
13	129	123	298	411	264	516	431	365	13	72	15	23	247	408	1,365	733	284
14	161	110	283	363	249	437	449	416	14	67	15	33	257	386	1,379	700	297
15	137	106	203	331	258	462	443	387	15	71	16	29	213	344	1,273	716	283
16	143	111	180	260	263	422	402	402	16	54	20	29	151	393	1,269	724	264
17	153	119	178	139	262	416	368	330	17	57	21	19	71	352	1,111	669	332
18	132	103	159	141	234	465	315	322	18	32	17	28	69	293	1,059	693	267
19	105	107	139	128	131	400	308	281	19	34	19	23	33	229	1,026	564	206
20	73	55	112	103	141	376	285	313	20	39	15	17	13	250	945	620	175
21	62	52	95	86	137	303	321	250	21	40	12	13	6	242	831	566	199
22	89	42	104	75	145	335	262	223	22	50	8	13	4	211	858	604	187
23	77	35	89	70	135	317	251	194	23	50	12	16	7	245	945	515	182
Total	2,759	1,805	3,019	3,978	4,604	9,610	7,677	6,685	Total	1,192	308	440	1,792	6,875	24,807	14,510	5,541
Per cent.	6.9	4.5	7.5	9.9	11.5	21.0	19.1	16.6	Per cent.	2.1	0.6	0.8	3.2	12.1	44.7	26.2	10.0

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

Hour.	JAN.							Hour.	AUGUST.							
	N.	N.E.	E.	S.E.	S.	S.W.	W.		N.W.	N.	N.E.	E.	S.E.	S.	S.W.	W.
0	42	12	14	33	239	1,145	566	121	0	23	30	211	923	626	208	
1	43	16	17	46	224	1,080	601	129	1	10	35	160	947	707	205	
2	34	17	11	55	218	1,123	628	141	2	0	41	188	905	708	260	
3	26	15	22	33	205	1,124	621	153	3	0	14	166	879	730	257	
4	46	17	12	32	229	1,106	615	144	4	16	28	169	980	677	261	
5	30	18	15	33	225	1,123	633	128	5	0	15	169	891	711	221	
6	41	23	18	28	208	1,139	552	117	6	0	25	162	892	706	199	
7	21	15	23	33	209	1,073	592	136	7	0	34	139	892	722	206	
8	24	15	21	50	328	1,153	585	158	8	4	44	224	908	742	248	
9	13	23	9	67	414	1,189	614	154	9	5	40	243	1,053	734	285	
10	53	32	28	123	422	1,403	641	193	10	26	68	301	1,127	816	382	
11	79	25	31	145	432	1,440	810	187	11	34	98	294	1,222	934	375	
Noon	62	31	29	189	445	1,484	832	236	Noon	24	112	290	1,245	955	451	
13	62	52	41	189	514	1,519	828	180	13	7	107	283	1,211	1,015	379	
14	62	48	26	179	479	1,518	765	196	14	2	79	265	1,252	1,075	336	
15	44	42	26	146	459	1,569	747	222	15	9	75	261	1,178	1,023	413	
16	30	41	48	127	402	1,517	711	194	16	0	57	227	1,263	933	350	
17	57	36	27	90	380	1,425	649	178	17	6	46	238	1,082	984	288	
18	47	39	25	74	368	1,289	610	159	18	10	48	226	1,080	735	249	
19	21	40	29	71	305	1,129	588	175	19	13	36	187	988	714	239	
20	15	39	24	58	260	1,137	580	158	20	13	35	182	920	659	195	
21	17	23	12	62	274	1,095	539	127	21	21	41	189	880	607	190	
22	32	16	12	48	293	1,069	603	189	22	15	44	174	872	619	218	
23	32	19	18	45	274	1,069	590	154	23	15	40	170	918	596	262	
Total	912	651	538	1,950	8,936	29,650	15,500	3,929	Total	267	1,213	5,118	24,521	18,758	6,680	
Per cent.	1.5	1.0	0.9	3.1	14.4	48.0	24.8	6.3	Per cent.	0.5	2.1	8.8	42.3	32.4	11.5	

TABLE 2 — Number of miles recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—contd.

SEPTEMBER.										OCTOBER.									
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.		
0	37	13	61	33	189	522	283	102	0	72	151	480	325	211	102	101	118		
1	33	13	63	50	216	530	343	114	1	65	144	404	363	201	125	94	112		
2	38	11	58	50	199	589	352	111	2	76	144	389	332	197	127	105	114		
3	42	10	45	34	179	627	285	139	3	77	143	379	296	200	121	108	139		
4	32	10	34	50	182	552	372	105	4	97	110	376	312	215	88	115	126		
5	34	17	33	47	173	572	355	137	5	98	119	408	277	191	96	152	115		
6	38	15	42	65	175	576	341	137	6	86	144	417	295	192	91	131	127		
7	29	24	32	65	241	527	344	147	7	102	180	439	269	203	121	119	158		
8	41	34	35	75	330	623	334	151	8	93	190	511	302	219	101	136	148		
9	36	54	53	111	363	666	358	159	9	128	193	533	287	236	135	145	181		
10	67	87	54	219	380	666	487	233	10	125	314	510	408	267	181	147	193		
11	79	79	98	289	464	667	541	263	11	166	351	654	453	303	196	185	183		
Noon	61	77	122	316	481	745	526	275	Noon	121	366	688	507	315	224	201	135		
13	55	68	168	306	438	736	612	276	13	106	323	685	533	335	261	213	173		
14	55	71	170	277	304	727	598	311	14	90	293	717	537	238	247	218	200		
15	122	67	105	255	315	687	577	301	15	118	279	655	479	311	212	215	221		
16	103	63	104	217	320	635	549	260	16	72	241	601	480	318	162	210	224		
17	90	48	101	125	238	625	543	271	17	76	198	627	372	305	135	196	235		
18	60	55	80	78	237	477	527	237	18	60	217	562	372	217	161	148	189		
19	50	35	66	74	212	462	430	184	19	65	214	591	310	195	161	118	152		
20	39	24	69	67	177	542	343	158	20	65	171	525	295	152	151	157	138		
21	32	12	71	68	218	475	296	149	21	48	131	512	323	160	101	127	108		
22	43	8	60	64	209	516	272	142	22	76	141	594	311	152	112	105	106		
23	38	9	69	43	210	535	286	135	23	74	163	510	338	191	118	81	106		
Total	1,254	891	1,796	2,978	6,510	11,299	9,944	4,500	Total	2,146	4,926	12,811	8,824	5,702	3,532	3,580	3,712		
Per cent.	3.0	2.1	4.3	7.1	16.5	33.9	23.6	10.7	Per cent.	4.7	10.9	28.4	19.5	12.6	7.8	7.8	8.2		

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Port Blair during 10 years—concl'd.

NOVEMBER.										DECEMBER.							
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
0	199	812	1,200	238	27	41	31	56	0	500	1,286	1,051	157	26	0	3	115
1.	180	773	1,155	280	27	54	36	58	1	489	1,181	986	206	44	5	2	117
2	199	747	1,082	279	25	37	47	58	2	492	1,188	817	232	18	12	5	148
3	170	722	1,012	265	17	50	42	78	3	485	1,103	856	226	26	0	2	174
4	191	691	1,074	289	23	47	44	69	4	464	1,178	854	195	36	2	7	197
5	222	660	1,097	229	23	44	35	89	5	532	1,131	853	188	21	3	4	184
6	219	701	1,127	246	38	52	46	119	6	596	1,137	820	212	17	1	8	183
7	240	773	1,058	252	33	47	57	115	7	600	1,154	783	227	19	4	8	201
8	235	840	1,045	317	51	48	48	125	8	580	1,200	918	260	10	1	6	185
9	221	893	1,088	271	42	48	43	129	9	578	1,218	921	261	15	1	10	175
10	239	1,089	1,109	285	63	54	46	99	10	634	1,334	923	245	11	0	8	144
11	227	1,036	1,360	354	51	67	26	58	11	596	1,355	971	274	22	1	4	141
Noon	159	1,052	1,532	394	62	81	23	47	Noon	605	1,431	992	251	22	1	7	135
13	163	974	1,531	468	88	60	51	57	13	614	1,324	1,021	248	31	2	14	118
14	191	1,007	1,414	410	69	46	64	59	14	571	1,315	971	239	42	1	10	130
15	145	1,021	1,370	411	54	64	63	93	15	570	1,290	971	193	35	3	19	113
16	161	955	1,368	397	38	58	51	85	16	527	1,337	942	196	50	0	17	103
17	161	913	1,409	418	47	40	52	93	17	559	1,338	812	262	38	11	7	103
18	160	905	1,352	360	42	49	34	86	18	577	1,334	874	229	34	0	8	115
19	184	936	1,210	316	32	27	44	71	19	600	1,346	892	214	20	1	14	117
20	170	910	1,158	297	55	31	46	69	20	578	1,356	890	208	43	3	20	132
21	166	882	1,159	293	32	36	45	54	21	529	1,307	915	189	37	5	7	126
22	202	858	1,236	247	23	26	52	55	22	582	1,259	924	189	20	4	2	140
23	190	832	1,250	272	18	29	39	60	23	521	1,266	982	180	17	12	0	161
Total	4,597	21,012	29,399	7,588	980	1,136	1,065	1,882	Total	13,379	30,368	21,912	5,231	666	73	192	3,470
Per cent.	6.8	31.1	43.5	11.2	1.4	1.7	1.6	2.8	Per cent.	17.8	40.3	29.1	7.0	0.9	0.1	0.3	4.6

TABLE 3.—*Number of miles recorded under each octant of the compass in each month of the year at Port Blair during 10 years.*

Month.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Total.
January . . . . .	17,480	23,691	8,672	605	0	0	21	1,645	52,321
February . . . . .	10,677	16,489	7,992	1,288	322	111	253	3,417	40,549
March . . . . .	7,502	11,204	7,076	1,238	62	152	460	3,375	31,059
April . . . . .	3,158	7,185	10,193	5,635	1,980	1,121	1,874	4,284	35,430
May . . . . .	2,750	1,805	3,019	3,978	4,604	9,610	7,677	6,685	40,167
June . . . . .	1,192	308	440	1,792	6,875	24,807	14,510	5,511	55,465
July . . . . .	942	651	538	1,956	8,986	29,950	15,500	3,929	62,455
August . . . . .	1,297	112	267	1,213	5,118	24,521	18,758	6,680	57,966
September . . . . .	1,254	904	1,796	2,978	6,540	14,299	9,914	4,500	42,215
October . . . . .	2,146	4,923	12,811	8,824	5,702	3,532	3,530	3,712	45,183
November . . . . .	4,597	21,012	29,329	7,583	980	1,136	1,065	1,882	67,659
December . . . . .	13,379	30,368	21,942	5,281	666	73	182	3,470	76,371
Sum. . . . .	66,393	1,18,658	1,04,145	42,376	41,835	1,03,342	73,784	49,320	6,05,853
Percentage . . . . .	11.0	19.6	17.2	7.0	6.9	18.0	12.2	8.1	100.0



ABLE 5.—Hourly co-ordinates of the mean diurnal variation of wind movement at Port Blair from the 10 years' registers of a Beckley's Anemometer. East and North are designated by +, South and West by — sign.

	NORTH AND SOUTH COMPONENT.		EAST AND WEST COMPONENT.	
	Observed.		Observed.	
Midnight to 1 . . . .	0·0		— 0·1	
1 to 2 . . . .	0·0		— 0·3	
2 to 3 . . . .	0·0		— 0·4	
3 to 4 . . . .	0·0		— 0·5	
4 to 5 . . . .	0·0		— 0·5	
5 to 6 . . . .	0·0		— 0·5	
6 to 7 . . . .	+ 0·1		— 0·5	
7 to 8 . . . .	0·0		— 0·5	
8 to 9 . . . .	0·0		— 0·5	
9 to 10 . . . .	+ 0·2		— 0·2	
10 to 11 . . . .	0·0		+ 0·3	
11 to noon . . . .	— 0·1		+ 0·5	
Noon to 13 . . . .	— 0·3		+ 0·6	
13 to 14 . . . .	— 0·2		+ 0·6	
14 to 15 . . . .	— 0·2		+ 0·6	
15 to 16 . . . .	— 0·3		+ 0·5	
16 to 17 . . . .	— 0·1		+ 0·4	
17 to 18 . . . .	— 0·1		+ 0·3	
18 to 19 . . . .	+ 0·2		+ 0·2	
19 to 20 . . . .	+ 0·2		0·0	
20 to 21 . . . .	+ 0·2		+ 0·1	
21 to 22 . . . .	+ 0·3		0·0	
22 to 23 . . . .	+ 0·1		+ 0·1	
23 to midnight . . . .	+ 0·1		0·0	
TOTAL . . . .	0·0		0·0	
Mean of day . . . .	0		0	

ABLE B.—Hourly co-ordinates of the mean diurnal variation of wind movement at Port Blair from the 10 years' registers of a Beckley's Anemometer. East and North are designated by +, South and West by — sign.

	NORTH AND SOUTH COMPONENTS.		
	Observed.	Observed.	
	EAST AND WEST COMPONENTS.		
Midnight to 1 .	0.0	0.0	0.0
1 to 2 .	0.0	0.0	-0.3
2 to 3 .	0.0	0.0	-0.4
3 to 4 .	0.0	0.0	-0.5
4 to 5 .	0.0	0.0	-0.5
5 to 6 .	0.0	0.0	-0.5
6 to 7 .	+0.1	0.0	-0.5
7 to 8 .	0.0	0.0	-0.5
8 to 9 .	0.0	0.0	-0.5
9 to 10 .	+0.2	0.0	-0.2
10 to 11 .	0.0	0.0	+0.3
11 to noon	-0.1	-0.3	+0.5
Noon to 12	-0.3	-0.2	+0.6
12 to 13	-0.2	-0.3	+0.6
13 to 14	-0.2	-0.3	+0.6
14 to 15	-0.2	-0.3	+0.6
15 to 16	-0.3	-0.3	+0.5
16 to 17 .	-0.1	-0.1	+0.4
17 to 18 .	-0.1	-0.1	+0.3
18 to 19 .	+0.2	+0.2	+0.2
19 to 20 .	+0.2	+0.2	0.0
20 to 21 .	+0.3	+0.3	+0.1
21 to 22 .	+0.3	+0.3	0.0
22 to 23 .	+0.1	+0.1	+0.1
23 to midnight	+0.1	0.0	0.0
Total	0.0	0.0	0.0
Mean of day	0	0	0



TABLE 6.—*Mean movement of air irrespective of direction in each hourly interval of each month as registered by a Beckley's anemograph at Port Blair from September 1894 to August 1904.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Midnight to 1 . . . . .	6.8	5.7	2.8	3.3	4.1	6.4	7.1	6.9	4.6	5.1	8.9	10.2	6.0
1 to 2 . . . . .	6.6	5.1	2.6	3.1	3.8	6.4	7.3	6.9	4.7	5.1	8.6	9.7	6.8
2 to 3 . . . . .	6.4	5.0	2.6	2.8	3.0	6.3	7.2	6.8	4.5	5.0	8.3	9.6	6.7
3 to 4 . . . . .	6.1	4.9	2.5	2.7	3.9	6.3	7.2	6.8	4.5	4.9	8.5	9.9	6.7
4 to 5 . . . . .	6.0	4.9	2.5	2.8	4.1	6.1	7.2	6.6	4.6	5.0	8.4	9.8	6.7
5 to 6 . . . . .	6.1	5.1	2.6	2.8	4.1	6.3	7.1	6.5	4.6	5.1	8.9	10.0	6.8
6 to 7 . . . . .	6.0	5.3	2.7	3.2	4.4	6.5	7.2	6.6	4.7	5.4	8.9	10.0	6.9
7 to 8 . . . . .	6.6	5.3	2.9	3.6	4.3	7.0	7.6	7.3	5.4	5.9	9.3	10.6	6.4
8 to 9 . . . . .	6.8	5.5	3.4	4.5	5.5	7.7	8.1	7.8	6.1	6.3	9.4	10.7	6.8
9 to 10 . . . . .	7.4	6.7	4.5	5.6	6.9	9.0	9.5	9.1	7.4	7.5	10.2	11.0	7.9
10 to 11 . . . . .	7.7	7.2	5.6	7.1	7.8	9.9	10.3	9.9	8.4	8.6	10.9	11.3	8.7
11 to noon . . . . .	8.1	7.4	6.2	7.7	8.4	10.5	10.8	10.3	8.8	9.1	11.5	11.5	9.2
Noon to 13 . . . . .	8.2	7.6	7.0	8.4	8.4	10.6	11.1	10.1	9.0	9.2	11.6	11.2	9.3
13 to 14 . . . . .	7.8	7.7	7.4	8.6	8.3	10.5	10.7	10.0	8.7	9.0	11.2	10.9	9.2
14 to 15 . . . . .	7.6	7.8	7.7	8.6	7.6	9.9	10.6	9.9	8.2	8.7	10.9	10.6	9.0
15 to 16 . . . . .	7.6	7.5	7.4	8.0	7.2	9.7	10.1	9.3	7.6	8.2	10.6	10.6	8.6
16 to 17 . . . . .	7.3	7.3	6.9	7.4	6.5	8.8	9.3	8.7	6.9	7.5	10.6	10.4	8.1
17 to 18 . . . . .	7.3	7.1	5.9	6.2	6.1	8.3	8.5	7.8	5.9	6.8	10.1	10.5	7.5
18 to 19 . . . . .	7.4	6.6	4.9	5.2	5.2	7.2	7.7	7.2	5.1	6.2	9.6	16.7	6.9
19 to 20 . . . . .	7.4	6.6	4.3	4.1	4.8	7.0	7.4	6.6	4.8	5.7	9.4	10.8	6.6
20 to 21 . . . . .	7.2	6.2	3.9	3.8	4.3	6.4	7.0	6.3	4.4	5.2	9.2	10.4	6.2
21 to 22 . . . . .	7.4	5.8	3.4	3.7	4.2	6.5	7.4	6.4	4.4	5.6	9.3	10.5	6.2
22 to 23 . . . . .	7.1	5.8	3.0	3.5	3.9	6.6	7.2	6.6	4.4	5.4	9.4	10.5	6.1
23 to midnight . . . . .	7.1	5.5	2.8	3.4	4.0	6.5	7.2	6.7	4.2	5.3	9.0	10.5	6.0
Total daily . . . . .	169.9	149.4	105.3	119.9	132.2	187.3	201.0	187.2	141.8	155.8	223.0	221.9	166.5
Mean hourly . . . . .	7.1	6.2	4.4	5.0	5.5	7.8	8.4	7.6	5.9	6.5	9.7	10.5	7.1



*Position of observatory latitude 26° 2' N longitude 90° 2' E. Elevation of anemograph cups above the ground 45 feet approximately, and of barometer above mean sea level 115 feet.*

1. *DESCRIPTION OF THE STATION.*—Dhubri is for administrative purposes in Assam,

but regarded geographically, is in the extreme north-east corner of the great plain of north Bengal at the mouth of the Assam valley. The station is built on a mass of rock rising from the surrounding alluvium to a height of about 20 feet above the flood level of the Brahmaputra at the point where the latter enters the plain of Bengal and turns southwards. All around it the land is low and is more or less subject to floods in the rainy season. The river channel, which is here about 6 miles across, is filled by the river at the height of the rains, and in the dry season presents a broad expanse of sand traversed by the shrunken but still imposing stream in a channel which varies from year to year. About 40 miles to the south-east the Garo hills rise to a height of 2,000 feet, and on the north at a greater distance are the outer spurs of the Bhutan Himalayas. The observatory stood on the north bank of the river, well exposed to the east, south and west, but was somewhat shielded on the north by numerous large trees which shaded the roads of the station. The anemograph was mounted on a tower, 45 feet above the ground, and its exposure was excellent.

2. *DATA.*—The data on which the following discussion is based are the tabulations of the hourly values of wind direction and velocity from the Beekley anemograph records. They are summarised in the tables and plates of the appendix. A comparison of the tabulated values with simultaneous eye observations published in the contemporary daily weather reports having shown that the records were very frequently open to doubt, the discussion has been confined to the larger features of the data. The tables and plates should be regarded as qualitatively rather than quantitatively accurate.

3. *CLIMATE OF DHubri.*—The town is situated at the mouth of the Assam valley and its climate is consequently intermediate between that of the plains of northern India, where there is a very definite dry hot season, and that of upper Assam where rainfall increases concurrently with temperature from the cool season to the middle of the rains. The cool season may be said to last from November to February. Both October and February are transition months exhibiting characteristics belonging to both the preceding and the following season, but on the average October may be included in the rainy season and February in the cool season. Rainfall diminishes rapidly through October to November and the rainfall of November and December is very small averaging only 0.4 inch in each of these months. Simultaneously temperature falls, especially at night, and the daily temperature range increases markedly. The lowest temperatures (both maximum and minimum) are recorded in January, but the daily range continues to increase slowly until March. After April the night temperatures rise while the day temperatures fall.

The "dry" hot season at Dhulri includes only the months of March and April. It is marked by higher maximum temperatures than occur at any other time of the year; but rainfall increases very rapidly during the period, so that "dry" is merely a relative term.

The rainy season begins in May, considerably before the south-west monsoon reaches India, and continues until September. The rainfall is not remarkably heavy and the season brings with it very little change of temperature. Maximum temperatures are a few degrees lower than those of April; but on the other hand minimum temperatures continue to increase until July and the highest mean temperature is recorded in this month. The daily range of temperature is largest in March and smallest in July.

The following are the data of the temperature and rainfall of the year:—

*Monthly mean temperature.*

—	Jan.	Feb.	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
Maximum	74.0	78.0	80.6	83.7	85.9	86.7	85.0	86.0	85.1	84.5	79.3	74.3
Minimum	63.1	66.0	63.4	70.7	73.2	76.4	78.3	78.3	77.0	72.8	63.5	55.1
Mean of Maximum and Minimum	69.3	65.6	73.3	78.9	78.7	79.7	81.0	80.7	79.4	77.3	70.6	63.4

*Monthly mean rainfall (inches).*

—	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
	0.39	0.55	1.86	5.01	16.14	25.28	16.71	12.18	13.32	3.75	0.11	0.14

4. SEASONAL AND YEARLY VARIATION OF WINDS.

(a) *Direction*.—The year may be divided into three seasons distinguished by characteristic winds. These seasons as given by the 6 years 7 months anemograph observations agree in general with the seasons determined by temperature and rainfall as described in section 3, but the accordance is not exact. For example, of the winds shown by plates XLVI to I those of February resemble those of March rather than those of January, the winds of April those of the rainy season rather than those of March, and the winds of September and October those of the cool season rather than those of the rainy season.

In the following, the winds will be considered according to the three periods into which they naturally fall, namely, September to January, February to March, and April to August. The first corresponds roughly to the cool, the second to the dry hot, and the third to the rainy season.

*September to January*.—The following table gives the percentage frequency of the various wind directions and of calms during the period, calms being defined by velocities less than 0.1 mile an hour. For details reference may be made to table I of the appendix.

TABLE 2a.

Month.	PERCENTAGE OF WINDS FROM								Percentage of calm.
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
September	4.0	23.0	18.3	4.9	10.9	19.6	4.7	2.5	12.0
October	6.3	26.5	22.2	4.5	9.4	14.6	3.2	1.6	12.6
November	6.8	39.6	33.7	2.9	4.0	3.9	0.3	0.9	8.9
December	3.9	40.9	34.8	3.3	4.2	2.7	1.4	1.6	7.1
January	6.1	28.9	23.6	6.5	6.8	14.2	6.5	0.8	9.6

NOTE.—Winds of indeterminate direction are neglected.

The most notable features are:—The large frequency of N. E. and E. winds throughout, the fairly large frequency of S. and S. W. winds during September, October and January; and the very small frequencies of other winds especially those from N. W. The position of the town at the mouth of the long and relatively narrow valley running east and west is favourable to the prevalence of winds between N. E. and E. and between S. and W., and the observations show that winds from directions outside these limits are infrequent at all times of year. The mean pressure gradients of the night and morning tend to give easterly winds at all seasons and westerly winds are due for the most part either to the effects of afternoon heating or to departures from the mean pressure gradients during the monsoon. The S. W. winds of September and October are associated with isobars running east and west at times when the trough of low pressure, usually over the Gangetic plain, is displaced northwards, and those of January are the continuation of the afternoon westerly winds of the Gangetic plain, which have been discussed by Sir John Elliot and others in previous volumes of these Memoirs.

*February and March.*—The following are similar data for this period:—

TABLE 3a.

Month.	PERCENTAGE OF WINDS FROM								Percentage of calm.
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
February	3.5	14.7	20.3	6.0	7.5	28.8	10.8	2.0	7.5
March	3.1	18.0	18.9	2.6	0.5	20.1	11.6	2.7	9.9

In February and March, S. W. to W. winds are the most frequent winds, but as indicated by plates XLIII, XLVI and XLVII they are relatively weak, the greatest movement continuing to be from easterly directions. They are afternoon winds forming roughly the continuation of the westerly afternoon winds of the Gangetic plain, and fall off rapidly after March owing to the intensification of the low pressures over the plains lying to the west. Easterly and northeasterly winds continue to prevail in the early morning.

*April to August.*—The following are similar data for this period:—

TABLE 4a.

Month.	PERCENTAGE OF WINDS FROM								Percentage of calms.
	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	
April	6.6	32.0	28.9	3.3	8.3	14.6	3.4	2.2	1.6
May	.	8.3	34.2	25.8	6.8	6.8	3.3	2.1	4.5
June	.	4.3	10.7	26.7	7.4	11.1	16.3	3.3	2.2
July	.	4.3	14.7	18.7	5.7	19.5	21.7	4.5	1.5
August	.	1.5	12.2	17.3	7.4	18.4	27.2	2.7	9.1
11.3									6.3

In April and May, pressure is higher in the east of the Assam valley than in the west throughout the day, and in consequence winds from N.E. and E. largely predominate. In April however the westerly afternoon winds of the Gangetic plain continue strong and winds from S.W. are fairly frequent at Dhubri in spite of adverse pressure gradients. The difference of pressure between the east and west of the Assam valley is smaller in June, July and August than in April and May, especially in the afternoon when the mean gradient at Dhubri is favourable for southerly winds and that in the upper valley favours westerly winds. From time to time also the trough of low pressure over the Gangetic plain, which is characteristic of the monsoon months, is displaced northwards against the Himalayas and gradients for westerly winds prevail across the whole of northern India. A large increase in the frequency of S. and S.W. winds results from these changes and during July and August winds from these directions are a good deal more frequent than those from N.E. and E. The S. and S.W. winds are however comparatively weak and the largest part of the total air movement continues to be from easterly directions. The proportion of calms is higher during the monsoon than from March to May.

*The Year.*—We may briefly summarise the data in the preceding as follows:—  
The predominant winds at Dhubri are those up and down the Assam valley. During November, December and May, down-valley winds very largely prevail, but up-valley winds are more numerous than down-valley winds in February, March, July and August. Calms are at a minimum in March and April. They increase in frequency during the monsoon to a maximum in September and October and then diminish to midwinter, after which their frequency increases slightly before falling to the April minimum.

## (b) VELOCITY.

*September to January.*—The following table gives for each month, the air movement recorded under each direction expressed as a percentage of the total movement for all directions, together with the actual average hourly velocity irrespective of direction:—

(For further details, see tables 2 and 5 and plates XLIII to XLV.)

TABLE 5a.

MONTH.	PERCENTAGE AIR MOVEMENT FROM										Average velocity in miles per hour.
	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.			
September	4.9	36.4	27.6	3.3	8.6	14.8	2.8	1.7	5.4	5.4	
October	6.2	38.2	29.3	3.3	7.4	12.3	2.3	1.0	4.9	4.9	
November	3.5	48.0	41.1	1.7	2.0	1.9	0.9	0.3	5.8	5.8	
December	2.7	47.9	41.8	1.8	2.6	1.8	0.7	0.7	5.7	5.7	
January	4.1	39.3	29.2	4.3	4.3	12.0	4.3	0.8	4.3	4.3	

The last column includes all movement whether the direction is determined or not; while the others are based *only on movement from definite directions*.

It appears from the above that the greatest movement is from the directions of greatest frequency. It is also evident from a comparison of the above table with table 2a that N. E. and E. winds are stronger than any others, the percentage movement for these directions being greater than their percentage frequency.

The maximum movement, irrespective of direction occurs in mid-winter during November and December when the gradients for easterly winds are fairly strong throughout the day.

*February and March.*—The following are similar data for this period:—

TABLE 6a.

Month.	PERCENTAGE AIR MOVEMENT FROM								Average velocity in miles per hour.
	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	
February	3.1	20.6	20.6	3.5	6.1	28.2	10.3	1.3	4.8
March	2.9	26.5	25.8	1.9	8.2	20.1	8.3	1.4	7.1

Comparing this table with table 3a, it appears that although in February and March, S. W. and W. winds become more frequent than N. E. and E. winds, the movement from the latter directions still predominates. It follows that N. E. and E. winds are considerably stronger than those from S. W. and W.

The last column shows that winds rapidly increase in strength during the two months.

*April to August.*—The following are similar data for this period:—

TABLE 7a.

Month.	PERCENTAGE AIR MOVEMENT FROM							Average velocity in miles per hour.
	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
April	.	.	.	.	.	.	.	1.3
May	.	.	.	.	.	.	.	1.4
June	.	.	.	.	.	.	.	1.0
July	.	.	.	.	.	.	.	1.1
August	.	.	.	.	.	.	.	1.4
	4.6	38.9	34.6	2.4	6.5	9.7	1.9	
	6.4	44.1	34.4	3.5	4.3	4.4	1.6	
	4.4	30.5	40.5	5.5	3.5	12.5	2.0	
	3.7	23.0	28.4	5.0	16.4	19.6	2.8	
	1.7	19.2	26.7	6.5	16.4	25.8	2.3	

The causes of the predominance of movement from N. E. and E. during this period have been discussed in the section on wind frequency. The above table shows that in August the air movement from S. W. and S. is nearly as great as that from N. E. and E., but comparison with table 4a shows that N. E. to E. winds continue to be the strongest winds.

The general air movement as represented by the last column diminishes continuously during the period from April to August.

*The Year.*—The preceding may be summarised briefly as follows:—

The air movement at Dhauri is predominantly down-valley throughout the year, although in February, March, July and August up-valley winds are the most frequent. This predominance is most marked in May, November and December, and least marked in February, March and August. Down-valley winds are also markedly the strongest winds.

The air movement irrespective of direction is most vigorous in April and May, and least so in January. It increases temporarily at the close of the monsoon in September, and again in November and December, before falling to its January minimum.

### 5.—DIRECTIONAL VARIATION.

#### (a) Direction.

The data of the daily variation of the resultant air movement are given in tables 4 and 5 and are plotted in plates XLVI to L and LIII and LIV.

The daily variation of wind direction appears to be due chiefly to the weakening of the pressure gradient in the afternoon over Assam and to the effects of convection during the day. The result is an oscillation of velocity and direction which gives the well-known rotation with the sun except during the late monsoon months. The surface pressure gradient at night and in the early morning is favourable for easterly or north-easterly winds throughout the year, and the corresponding winds reach their maximum strength at about 10 hours. In the afternoon, pressure gradients diminish in intensity and this combined with the effects of afternoon convection produces either a large diminution in the velocity of the north-easterly and easterly winds, or reverses them and gives



southwesterly winds. This effect of afternoon convection is probably due to the shallowness of the pure surface winds and the prevalence of westerly winds in the layers above them. The surface pressure distribution over northern India changes rapidly with height and gives place to gradients which are favourable for westerly winds throughout the year.\*

#### (b) *PRECIPIT.*

Data regarding the daily variation of wind velocity are given in tables 4, 5 and 6 and are plotted on plates XLVI to LIV.

The principal feature of the daily variation of velocity irrespective of direction is, throughout the year, a single oscillation with a maximum at about 10 hours and a minimum which occurs most frequently at about 20 hours, but varies between that time and midnight. The oscillation is most marked in November and December when the maximum is greater and the minimum smaller than in other months, and least marked in July and August owing to the low value of the maximum. In February and March there is a secondary maximum at about 15 hours corresponding to the time of maximum up-valley movement.

The diminution of velocity after 10 hours has been explained in the previous section by convective mixing after that hour with upper winds from directions opposed to the lower winds. A comparison of plates XLVI to LIV with the corresponding plates for Roorkhee (see Volume XVII, number 7) renders this point clearer. At Roorkhee the type of the daily variation of velocity changes to that which is characteristic of Dhubbri when easterly winds set in, towards the end of the hot season. These winds are strengthened by the convection of the morning but are weakened and even reversed by mixing with the upper westerly winds in the afternoon. Similar daily variations occur at various other stations in India and may be explained on the same basis.

#### STORM WINDS.

Dhubbri is affected by two types of storm, namely, those of the winter which enter India through Persia and move eastwards across the northern part of the country, and those of the early and the late southwest monsoon months from the Bay of Bengal. The former occur from November to March and are most numerous in January. They usually pass eastwards to the south of Dhubbri, but occasionally in February the centre of one of these storms passes directly over the station. Storms of the southwest monsoon type from the Bay of Bengal pass close to the station in May and June and again from August to November. The storms of July almost invariably move west-north westwards, from the head of the Bay and do not approach Dhubbri. They are instrumental, however, in largely strengthening the north-easterly winds there, even when their centres are far distant from the station.

A good example of the winter type of storm is that of January 1893. The storm entered India from Baluchistan on January 22nd, and moving eastwards, began to affect the winds at Dhubbri on 24th. It was situated over Bengal and the north of the Bay at 8 hours on the 26th, but on the following day the lowest pressures were along the Assam

Himalayas and in central Burma. The winds at Dhubri indicate that part of the storm moved over the station from the south on the 26th and disappeared in the Himalayas. Data are given below:—

Date.	0		4		8		12		16		20	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
January 24th	E.N.E.	2	E.N.E.	10	E.	18	E.	10	E.	1	E.	2
" 25th	E.	6	E.N.E.	16	E.	11	E.	25	E.N.E.	12	E.	16
" 26th	E.	9	E.N.E.	7	E.	5	N.E.	3	W.	6	W.	4
" 27th	W.	7	W.	8	S.W.	9	W.S.W.	11	W.S.W.	4	W.S.W.	2
" 28th	S.W.	5	S.W.	5	E.	11	E.	4	E.S.E.	1	E.S.E.	1

The wind backed from N.E., through N.W. to W. between 13 and 14 hours on the 26th. The maximum hourly movement was 30 miles from the east between 11 hours and noon on the 25th. These storms usually strengthen the easterly winds at Dhubri, and the above example shows that on the infrequent occasions when they pass north of the station they may reverse the prevailing pressure gradients and give rise to westerly winds. Storms of the monsoon type are in general much more intense than those of the winter. They usually strengthen largely the N.E. and E. winds of Dhubri. The following are data for a storm which entered Bengal from the Bay on May 26th 1893, moved in a northeasterly direction to the south of the Garo hills, and disappeared on the 29th.

Date.	0		1		5		12		16		20	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
May 26th	N.N.E.	3	N.N.E.	8	E.	16	E.	20	E.S.E.	17	E.S.E.	22
" 27th	E.	26	E.	33	E.	27	E.	38	E.	38	E.	47
" 28th	E.N.E.	35	E.N.E.	34	E.N.E.	34	N.E.	30	E.N.E.	20	E.	32
" 29th	E.N.E.	26	E.N.E.	14	N.E.	14	E.	17	E.	14	E.	10

The wind velocity was high throughout the 27th and 28th and frequently exceeded 35 miles in one hour. The maximum hourly movement was that recorded at 20 hours on the 27th. This storm moved eastwards to the south of Dhubri, while the majority of early and late monsoon storms passing near Dhubri move northwards to the west of the station. There was however no good example of an intense storm of the latter type during the period covered by the anemograph observations. The daily weather reports of other years show that these storms also give very strong easterly winds at Dhubri, and that many of the storms moving west north-westwards in July have the same effect. The direction of the strong winds as a rule rotates in accordance with the change of barometric gradient due to the movement of the storm.

TABLE I.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Diubiri during 6-7 years.

JANUARY.										FEBRUARY.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	14	69	41	11	12	31	13	2	31	0	7	19	29	4	12	50	20	5	21
1	16	61	41	14	13	32	10	2	23	1	8	21	29	8	13	45	19	4	20
2	16	61	40	14	12	29	10	2	28	2	10	23	28	8	12	49	10	3	15
3	17	61	43	15	11	30	9	1	25	3	10	24	29	8	18	52	16	3	12
4	16	70	42	16	13	30	11	1	13	4	8	26	30	10	14	50	14	4	11
5	15	69	43	15	14	32	10	1	13	5	7	25	30	9	18	51	11	5	16
6	18	66	42	13	14	30	9	2	17	6	8	24	34	7	13	48	13	4	16
7	17	71	45	14	13	29	10	3	9	7	8	27	33	6	16	51	13	3	10
8	15	75	45	13	14	28	8	2	11	8	10	26	33	9	17	46	10	6	9
9	10	79	69	17	13	25	7	1	3	9	8	32	38	10	17	43	10	3	7
10	14	73	65	16	10	25	9	1	2	10	5	36	43	10	16	39	9	4	1
11	4	72	72	18	10	19	10	1	0	11	4	36	53	12	14	36	9	2	3
Noon	5	64	77	16	11	20	9	1	12	Noon	...	35	56	9	11	38	10	2	7
13	6	64	70	15	13	24	9	1	13	13	...	33	51	11	9	48	9	1	5
14	8	61	66	13	14	30	8	1	14	14	2	28	44	9	12	51	10	2	9
15	6	58	57	14	13	36	11	...	23	15	3	24	32	9	13	52	22	3	9
16	6	53	45	12	15	41	14	1	27	16	3	20	30	11	14	55	26	2	6
17	7	54	43	10	12	38	20	1	31	17	4	18	27	8	14	55	31	2	8
18	6	55	51	12	12	37	20	1	21	18	4	22	24	7	9	51	32	2	16
19	9	53	49	12	12	37	18	2	23	19	6	18	26	8	8	50	29	3	19
20	9	51	45	11	13	30	15	3	38	20	7	17	22	8	11	47	29	3	23
21	12	52	39	14	10	30	15	4	39	21	8	19	28	7	10	45	26	5	10
22	9	49	44	14	11	33	15	3	37	22	6	21	28	7	9	50	24	4	18
23	9	54	45	14	11	31	14	3	34	23	5	16	32	6	12	51	22	4	19
Total .	261	1,485	1,208	833	296	727	284	40	493	Total .	141	590	813	201	301	1,153	433	79	299
Per cent..	5.1	28.9	23.5	6.5	5.8	14.2	5.5	0.8	9.6	Per cent..	3.5	14.7	20.3	5.0	7.5	28.8	10.8	2.0	7.5

Velocities of less than 0.1 mile an hour are taken as calm.

TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Dhului during 6-7 years—continued.

MARCH.										APRIL.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	7	31	80	5	25	75	25	8	5	0	10	62	43	7	19	38	19	5	3
1	7	31	29	5	24	73	18	7	13	1	12	61	46	7	24	28	24	5	6
2	12	37	31	6	23	68	15	10	10	2	11	66	45	9	22	26	22	5	4
3	10	47	29	2	25	66	13	10	8	3	15	71	43	7	22	27	22	3	3
4	10	51	34	5	26	63	13	9	4	4	16	70	40	9	20	25	20	5	4
5	13	50	39	4	24	67	12	7	4	5	16	72	40	8	17	20	17	7	2
6	12	53	40	2	24	65	11	8	5	6	18	72	51	7	12	19	12	9	2
7	12	56	43	2	21	62	9	5	9	7	17	75	56	8	9	16	9	6	3
8	12	56	43	2	21	62	8	5	5	8	16	76	63	6	9	12	12	6	—
9	9	58	62	4	23	47	8	3	2	9	13	74	74	5	8	12	12	5	—
10	9	58	70	8	16	37	11	2	—	10	11	71	81	5	7	12	12	5	1
11	5	55	73	5	18	41	10	2	1	11	7	77	80	6	7	14	14	5	2
Noon	4	46	77	5	17	49	9	2	1	Noon	6	66	74	6	6	10	10	2	2
1	5	46	77	5	17	49	9	2	1	13	6	64	70	6	13	26	16	3	2
2	5	31	78	7	20	60	10	—	3	14	6	67	67	10	22	39	24	2	2
3	6	28	53	13	18	70	14	2	5	15	4	40	57	6	24	30	23	2	3
4	3	23	36	8	25	79	26	4	4	16	6	48	48	7	23	47	19	1	—
5	4	17	25	7	19	84	36	3	4	17	9	47	48	7	10	48	15	—	—
6	2	21	20	4	16	86	52	3	6	18	7	47	51	7	10	46	17	2	7
7	3	19	19	5	10	74	62	5	12	19	8	47	50	5	16	42	16	2	7
8	4	21	21	5	11	68	53	7	14	20	12	47	51	6	13	35	13	5	6
9	9	26	18	4	12	70	55	10	6	21	8	52	50	8	13	34	13	4	6
10	6	30	21	7	14	69	45	8	10	22	15	53	50	7	15	32	10	6	5
11	4	30	25	6	21	72	36	8	8	23	10	53	51	7	15	32	10	6	5
12	5	28	31	6	26	71	29	7	8	23	10	55	54	8	17	32	7	8	3
Total	173	905	940	133	477	1,529	585	135	147	Total	239	1,455	1,310	103	386	676	156	103	73
Per cent.	3.4	18.0	18.9	2.6	9.6	30.4	11.6	2.7	2.9	Per cent.	5.6	32.0	28.9	3.6	8.3	14.6	3.4	2.2	1.6

Velocities of less than 0.1 mile an hour are taken as calm.

TABLE I.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Dhobri during 6-7 years—continued.

N.E.										S.E.									
Hour.	N.	N.E.	E.	E.S.	S.	S.W.	W.	W.S.	W.	Hour.	N.	N.E.	E.	E.S.	S.	S.W.	W.	W.S.	W.
0	10	71	16	13	14	15	6	6	11	0	6	29	31	11	13	21	7	1	20
1	10	70	40	0	0	21	7	6	6	1	6	23	37	16	15	17	6	6	10
2	50	10	41	7	11	17	0	0	12	2	6	29	33	13	16	16	6	4	18
3	23	20	33	11	13	13	7	0	7	3	7	27	41	13	16	16	7	4	11
4	28	75	17	8	10	11	7	8	0	4	10	26	41	10	16	18	6	4	11
5	23	71	43	7	15	14	6	10	0	6	7	21	41	8	19	22	6	6	10
6	27	71	41	10	13	17	6	6	6	6	8	29	39	13	18	17	4	6	11
7	23	69	29	7	13	13	11	7	10	7	6	25	29	11	16	17	6	6	13
8	22	74	63	4	12	11	12	6	6	6	8	37	41	11	11	21	3	4	6
9	20	72	61	6	12	10	11	6	6	0	7	41	46	0	12	10	3	4	10
10	17	69	73	5	11	11	7	3	4	10	7	38	50	0	11	21	6	1	6
11	13	72	75	0	12	11	6	4	2	11	7	36	45	6	16	21	6	4	6
Noon	15	73	67	12	14	11	3	6	3	13	7	35	40	7	13	21	4	2	4
1	15	68	70	11	12	16	7	1	3	13	7	30	42	12	13	23	4	2	3
2	14	61	69	21	13	20	0	2	5	14	6	31	41	10	17	30	6	2	3
3	13	65	61	20	17	23	6	2	7	16	5	29	42	11	17	32	6	2	4
4	16	61	63	11	20	23	3	2	7	16	0	23	38	0	17	35	6	4	8
5	11	66	59	14	19	21	0	2	11	17	6	23	39	8	21	30	6	3	12
6	9	67	42	15	15	23	7	2	21	18	4	23	32	12	22	33	6	3	13
7	13	63	59	11	16	22	8	3	16	20	4	23	33	0	19	39	2	3	23
8	10	70	60	18	16	15	0	1	16	20	4	24	33	12	19	39	4	1	23
9	12	70	60	11	17	21	8	1	11	21	4	22	33	13	17	28	4	3	24
10	13	69	61	13	14	18	10	4	16	22	5	22	35	16	17	27	5	8	10
11	15	67	60	16	16	16	9	6	13	23	7	26	29	16	17	22	6	2	25
Total	409	1,691	1,276	251	537	423	190	106	222	Total	163	617	913	292	394	678	118	70	314
Percent.	3.3	34.2	25.8	6.6	6.8	8.6	3.8	2.1	4.6	Percent.	4.3	10.7	20.7	7.4	11.1	16.3	3.3	2.2	8.9

Verticals of the lines of miles as shown in the column.

TABLE I.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Dhubri during 6-7 years—continued.

JULY.										AUGUST.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	7	18	23	8	34	33	8	1	11	0	1	16	25	14	24	43	4	2	26
1	6	20	22	7	35	36	6	2	10	1	2	16	25	0	33	41	4	2	23
2	6	23	22	4	32	40	7	1	9	2	2	17	25	11	35	42	3	3	17
3	6	22	24	3	32	37	7	2	11	3	1	17	24	14	32	45	4	2	16
4	4	23	29	6	34	36	5	3	4	4	2	18	27	12	29	40	4	2	21
5	6	23	33	6	28	34	5	3	5	5	3	17	29	14	23	35	4	4	26
6	10	21	30	8	29	31	4	2	6	6	2	20	33	14	27	31	7	4	17
7	7	23	36	7	28	32	4	2	5	7	3	20	35	14	26	36	3	5	13
8	7	25	33	9	25	29	5	3	7	8	3	23	34	13	25	38	2	3	11
9	9	27	36	7	21	28	0	2	7	9	2	24	36	12	25	34	1	4	17
10	8	27	38	6	19	29	5	2	0	10	4	25	35	12	24	37	1	3	14
11	8	30	39	6	15	32	7	2	5	11	5	27	34	12	21	40	1	3	9
Noon	9	34	34	6	16	31	6	3	4	Noon	5	29	29	0	27	40	3	1	12
13	8	32	31	5	21	32	5	4	5	13	4	26	20	12	32	38	4	4	9
14	7	27	25	10	21	35	9	3	6	14	4	10	30	10	32	46	4	4	6
15	8	24	19	8	27	43	7	...	7	15	2	15	27	13	32	51	6	3	6
16	4	19	21	14	21	42	9	1	9	16	3	15	22	13	34	51	7	3	7
17	3	13	22	12	26	44	10	4	9	17	1	14	20	13	29	51	6	4	14
18	3	12	23	8	30	43	8	3	13	18	1	14	20	11	33	52	7	5	12
19	4	13	16	11	30	39	8	3	10	19	1	14	20	9	31	44	7	4	25
20	5	12	17	11	36	39	5	2	16	20	1	15	21	7	26	39	5	2	39
21	4	13	20	13	33	35	6	1	18	21	1	17	21	9	30	46	5	4	22
22	7	12	23	11	33	31	6	2	18	22	1	16	21	10	27	42	4	5	39
23	5	13	28	11	32	36	8	1	9	23	2	18	23	9	25	45	4	2	27
Total	148	606	643	195	670	847	156	52	215	Total	66	452	642	276	685	1,010	100	73	418
Per cent.	4.3	14.7	18.7	6.7	10.6	24.7	4.5	1.6	6.3	Per cent.	1.6	12.2	17.3	7.4	13.4	27.2	2.7	2.1	11.2

Velocities of less than 7 miles an hour are taken as calm.

TABLE 1.—Number of scuds recorded under each octant of the compass at each hour in each month of the year at Dhulri during 6-7 years—continued.

JULY.										OCTOBER.										
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Cal.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Cal.	
0	6	31	25	11	20	32	7	4	20	0	10	43	25	11	43	35	8	21	29	0
1	4	34	27	0	20	33	5	3	27	1	11	42	38	0	42	38	0	20	26	2
2	6	35	27	7	22	30	6	1	27	2	12	40	33	6	40	33	6	16	27	3
3	0	37	27	8	18	20	7	3	26	3	12	31	36	12	31	36	12	15	25	4
4	0	35	31	6	16	32	6	6	21	4	14	32	35	10	22	22	7	22	26	2
5	10	30	32	0	16	32	6	6	20	6	13	32	37	12	22	22	6	22	23	2
6	0	33	32	0	15	25	6	6	15	6	11	31	36	0	30	18	0	24	23	3
7	0	30	36	6	10	31	7	6	14	7	11	26	42	0	19	24	0	19	25	6
8	7	30	36	0	15	31	6	6	10	8	11	27	45	11	17	23	8	17	24	4
9	10	40	39	7	16	32	6	6	8	0	0	25	35	0	0	17	7	21	24	3
10	0	45	39	6	16	26	7	6	12	10	2	25	35	2	11	27	11	24	27	7
11	0	42	43	5	19	31	5	4	12	11	4	29	26	6	15	25	6	16	25	2
Non	5	45	50	6	12	30	0	6	12	Non	8	24	26	11	21	26	6	21	26	1
13	11	45	54	5	15	25	8	7	7	13	0	32	31	0	12	26	11	12	26	3
14	12	45	51	10	16	50	11	6	4	14	11	33	31	11	10	31	12	10	31	10
15	11	43	29	0	17	51	11	4	5	15	7	34	41	13	16	30	13	16	30	6
16	7	49	20	11	19	35	10	4	8	16	8	41	39	13	18	32	13	18	32	4
17	4	36	20	5	22	33	10	4	18	17	0	41	32	6	19	32	6	19	30	4
18	3	36	24	4	20	35	5	4	30	18	0	42	30	6	17	30	5	17	27	6
19	4	51	21	6	21	37	5	2	31	19	0	42	32	7	18	27	3	18	27	4
20	3	32	23	5	20	37	8	2	31	20	0	41	36	7	18	27	3	18	27	4
21	3	35	23	8	21	31	7	2	30	21	11	40	35	5	16	29	5	16	29	3
22	2	32	24	10	17	23	8	3	38	22	11	41	32	6	19	29	6	19	29	1
23	5	33	22	11	20	32	0	3	31	23	12	45	35	7	19	29	7	19	29	2
Total	169	913	726	163	431	777	187	59	476	Total	236	1,150	969	202	417	632	111	70	632	
Percent.	49	290	183	49	100	196	47	25	120	Percent.	53	265	223	45	94	146	32	10	126	

Values of less than 1 are not entered.

TABLE 1.—Number of winds recorded under each octant of the compass at each hour in each month of the year at Dhauri during 6-7 years—concluded.

NOVEMBER.										DECEMBER.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
0	14	81	69	6	10	10	...	2	18	0	9	90	70	7	9	6	4	4	17
1	20	83	58	7	8	11	...	3	20	1	14	98	65	6	9	6	4	3	16
2	19	97	50	7	9	9	...	3	16	2	15	97	65	6	9	5	2	4	13
3	17	88	62	8	9	10	...	3	13	3	14	99	66	5	12	7	3	5	5
4	17	91	61	8	8	11	...	3	8	4	18	99	68	6	12	5	4	4	5
5	17	95	60	8	7	9	1	3	10	5	13	98	66	7	12	5	4	4	7
6	16	96	63	9	8	8	1	2	5	6	14	103	61	6	12	5	3	4	8
7	17	95	68	9	7	7	2	1	4	7	11	105	65	6	11	6	3	4	5
8	14	96	72	8	7	7	...	2	3	8	9	103	69	7	9	4	3	3	6
9	6	101	77	9	6	7	1	1	2	9	8	108	70	8	9	3	1	5	5
10	12	95	78	8	6	7	...	1	3	10	4	102	80	8	10	3	1	5	3
11	3	93	88	6	4	7	...	...	9	11	2	99	89	6	8	4	1	4	3
Noon	3	90	90	4	5	7	...	...	13	Noon	4	85	94	7	9	5	1	2	9
13	3	84	92	3	8	5	...	...	15	13	...	82	102	7	8	6	2	1	9
14	6	79	90	6	7	7	...	...	15	14	3	77	97	11	9	7	3	2	7
15	12	75	88	5	10	7	1	1	11	15	4	76	83	10	11	7	3	3	18
16	11	75	71	3	10	9	2	3	26	16	7	79	81	7	8	9	5	8	17
17	12	71	68	3	10	8	1	3	34	17	8	82	77	7	7	9	4	4	18
18	11	67	74	5	9	8	1	2	33	18	8	76	76	8	6	8	4	3	27
19	10	65	65	5	13	8	1	2	41	19	7	75	71	7	7	8	3	3	35
20	12	64	59	3	9	9	1	3	50	20	7	71	71	7	7	6	4	2	41
21	13	64	61	5	10	9	1	2	42	21	8	70	68	6	9	6	3	3	43
22	14	75	61	6	12	9	...	2	28	22	9	71	74	9	8	6	3	4	32
23	12	74	67	6	12	8	...	2	29	23	12	79	74	7	8	7	4	4	21
Total	291	1,997	1,770	147	204	165	13	44	448	Total	203	2,119	1,801	171	219	141	71	83	370
Per cent.	5.8	39.6	33.7	2.9	4.0	3.9	0.3	0.9	8.9	Per cent.	3.0	40.9	34.8	3.3	4.2	2.7	1.4	1.6	7.1

Velocities of less than 0.1 mile an hour are taken as calm.



TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhumbri during 6-7 years.

JANUARY.										FEBRUARY.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
0	35	105	132	27	30	92	45	4		0	28	88	126	15	37	161	77	15	
1	45	212	130	35	41	107	35	6		1	14	86	134	23	40	156	79	14	
2	53	206	160	33	39	109	42	9		2	21	67	131	33	33	170	80	9	
3	66	216	160	35	34	111	36	8		3	38	121	136	19	38	182	59	5	
4	63	270	167	42	35	116	39	3		4	26	161	164	30	43	194	48	5	
5	63	309	151	39	32	103	40	6		5	33	172	170	26	41	215	40	14	
6	60	311	104	44	26	93	31	9		6	30	151	242	18	55	208	42	15	
7	74	363	139	40	33	91	30	12		7	22	142	201	15	49	188	43	10	
8	57	408	223	43	47	92	27	4		8	45	139	222	28	76	173	33	16	
9	33	616	415	67	45	110	26	3		9	30	223	346	41	82	195	33	8	
10	38	862	610	66	38	126	43	13		10	26	368	514	41	65	208	48	6	
11	14	777	728	58	41	89	47	4		11	21	384	530	48	49	207	51	5	
Noon	16	653	743	58	40	100	35	3		Noon	8	322	416	25	50	241	68	6	
13	28	582	527	50	54	147	45	10		13	4	212	228	22	46	309	67	1	
14	44	497	397	52	66	194	50	5		14	28	123	191	28	59	355	81	6	
15	25	414	283	49	62	227	68	1		15	22	107	126	40	72	337	145	11	
16	22	346	215	39	81	215	79	6		16	12	100	99	41	66	335	158	9	
17	18	288	155	19	37	142	67	1		17	23	65	100	20	44	252	154	5	
18	15	210	150	20	21	88	50	1		18	16	88	72	9	30	146	97	3	
19	34	170	131	21	28	86	46	16		19	27	66	71	16	18	125	80	8	
20	31	157	130	21	24	73	41	11		20	34	65	64	17	31	118	79	3	
21	55	155	116	25	23	63	47	14		21	54	85	91	17	28	126	87	15	
22	31	157	137	26	36	103	49	10		22	13	112	94	20	20	144	79	15	
23	30	176	137	23	27	104	44	10		23	11	93	139	16	37	166	86	14	
Total .	949	8,580	6,370	932	943	2,811	1,052	169		Total .	586	3,570	4,607	608	1,109	4,911	1,798	218	
Per cent. .	4.4	39.3	29.2	4.3	4.3	12.9	4.8	0.8		Per cent. .	3.4	20.5	26.5	3.5	6.4	28.2	10.3	1.3	

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhulri during 6-7 years—continued.

March.										April.									
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
0	32	232	208	24	132	353	70	22		0	57	609	414	39	101	162	15	30	
1	30	296	233	17	130	350	48	24		1	81	615	442	51	184	160	14	20	
2	75	353	295	18	111	303	42	27		2	64	719	441	57	173	149	13	26	
3	48	408	335	8	143	255	50	27		3	89	716	427	30	175	139	9	22	
4	43	464	365	35	119	264	47	30		4	114	691	436	47	171	132	18	28	
5	69	412	393	28	106	244	40	27		5	100	739	531	45	122	95	11	23	
6	69	467	405	10	113	240	53	27		6	144	751	533	45	87	102	6	47	
7	69	485	435	8	98	227	25	14		7	134	827	667	73	71	95	7	18	
8	83	533	494	16	118	231	28	15		8	106	852	759	35	60	65	11	29	
9	24	630	757	44	101	217	21	7		9	111	935	1,001	34	65	85	1	25	
10	39	610	871	42	109	253	45	8		10	104	937	1,161	30	70	101	7	25	
11	25	538	786	41	128	314	62	6		11	59	945	1,100	28	76	133	...	27	
Noon.	16	409	632	25	130	446	51	8		Noon.	70	871	944	40	131	190	18	22	
13	20	232	440	25	159	543	75	1		13	63	838	780	51	161	261	34	5	
14	38	279	255	54	136	679	157	11		14	75	772	613	71	201	338	53	17	
15	15	240	179	38	176	721	240	30		15	56	652	635	52	211	368	102	8	
16	22	187	149	20	127	788	329	10		16	60	675	526	31	219	439	103	13	
17	30	228	169	11	95	555	375	8		17	90	667	581	57	146	366	106	...	
18	41	204	153	16	66	565	289	28		18	46	663	522	24	116	215	79	34	
19	44	220	135	33	68	246	180	31		19	66	678	553	37	73	160	75	8	
20	74	242	138	16	55	247	165	30		20	112	635	513	50	62	127	56	68	
21	31	239	210	28	64	253	143	29		21	45	505	625	47	62	141	25	17	
22	13	235	181	34	103	318	118	28		22	136	556	475	38	68	117	47	33	
23	20	188	214	30	144	320	89	15		23	48	531	520	33	85	141	31	42	
Total	952	8,487	8,577	621	2,711	8,673	2,747	463		Total	2,030	17,169	15,282	1,045	2,330	4,230	343	592	
Per cent.	2.0	25.5	25.3	1.9	8.2	26.1	8.3	1.4		Per cent.	4.6	38.0	34.6	2.4	6.5	9.7	1.0	1.3	

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhivri during 6-7 years—continued.

MAR.									JUNE.								
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
0	131	634	343	73	81	72	9	10	0	40	207	220	49	78	65	36	20
1	105	669	485	21	68	73	19	12	1	36	231	266	62	58	62	11	28
2	132	674	386	21	71	70	29	37	2	42	260	271	63	60	80	16	23
3	160	734	416	61	62	48	21	43	3	30	222	283	48	63	87	30	21
4	178	692	513	31	44	47	27	38	4	62	227	376	28	69	93	14	19
5	138	664	479	26	79	60	29	47	5	60	220	365	25	86	82	19	36
6	166	747	490	33	46	62	12	49	6	49	274	366	47	65	67	9	21
7	191	714	666	33	55	60	29	43	7	61	263	399	51	76	67	27	34
8	114	744	662	9	33	32	37	19	8	47	344	435	44	64	83	7	13
9	135	844	816	34	63	43	27	16	9	42	439	614	43	59	105	13	13
10	119	867	898	44	66	63	18	8	10	53	402	600	51	44	104	32	4
11	87	839	865	64	64	43	18	21	11	63	412	626	25	76	93	22	15
Noon	100	923	773	81	88	43	16	40	Noon	69	473	641	37	68	168	18	10
13	107	876	764	83	67	84	31	8	13	48	428	497	43	83	183	22	6
14	107	717	627	121	84	113	29	7	14	47	389	601	38	90	187	22	2
15	86	730	671	94	110	119	39	8	15	34	297	476	64	98	201	20	6
16	47	675	560	66	121	124	37	26	16	43	227	304	51	89	209	19	7
17	61	710	603	40	78	106	37	11	17	35	208	368	55	94	163	26	4
18	45	709	438	61	67	98	19	2	18	16	230	287	60	100	161	17	5
19	80	677	491	71	68	76	20	36	19	12	192	272	35	85	110	7	9
20	62	610	468	85	63	63	17	6	20	14	184	221	35	65	89	13	7
21	68	683	479	76	70	77	17	6	21	17	165	220	47	65	88	6	5
22	77	690	486	62	64	73	39	6	22	33	168	249	51	68	99	13	16
23	101	647	416	66	79	67	28	34	23	39	260	297	72	64	97	17	4
Total	2,487	17,063	13,316	1,346	1,649	1,684	604	642	Total	304	6,616	8,831	1,114	766	2,713	436	328
Percent.	6.4	44.1	34.4	3.6	4.3	4.4	1.6	1.4	Percent.	4.4	30.6	40.6	6.6	3.6	12.6	2.0	1.0

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhului during 6-7 years—continued.

June.									August.								
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
0	46	135	164	31	146	156	19	7	0	6	109	133	58	108	139	11	3
1	26	153	157	32	158	166	18	13	1	5	119	151	38	130	155	10	7
2	23	186	177	14	162	172	42	3	2	12	147	135	57	146	153	10	9
3	48	158	188	15	174	170	26	9	3	8	147	125	70	139	205	18	6
4	32	199	252	21	130	197	16	18	4	9	175	145	46	126	193	21	7
5	38	214	252	33	144	159	13	16	5	18	146	194	54	119	169	23	28
6	30	231	252	33	153	172	17	12	6	8	146	242	54	108	151	45	17
7	40	245	33	30	140	152	8	14	7	19	147	320	84	127	164	11	18
8	32	215	333	38	157	168	12	15	8	15	179	309	66	90	174	12	14
9	41	272	418	36	113	126	27	11	9	13	185	362	41	113	158	7	14
10	32	316	440	29	105	143	18	7	10	38	196	383	64	103	152	8	12
11	41	319	403	26	81	143	28	9	11	37	247	316	51	101	202	6	10
Noon	29	344	355	25	82	153	15	17	Noon	17	238	280	45	123	208	14	1
13	24	300	276	21	100	167	18	13	13	19	210	250	56	175	233	20	8
14	28	274	193	43	109	160	46	12	14	32	121	261	31	170	276	18	14
15	55	228	135	44	143	243	31	1	15	13	106	226	60	156	325	33	12
16	26	141	168	59	118	220	43	3	16	14	134	168	54	165	229	40	7
17	6	91	164	63	114	213	39	10	17	9	120	175	46	146	280	29	12
18	14	88	146	101	142	192	23	7	18	6	106	138	56	142	218	27	12
19	14	72	115	40	170	159	24	6	19	2	109	109	29	120	156	19	6
20	14	88	132	36	143	138	12	5	20	2	110	124	27	108	154	17	10
21	17	85	179	56	149	133	17	4	21	4	116	116	29	110	181	11	12
22	35	82	189	62	113	119	15	8	22	1	107	123	47	107	174	8	12
23	43	88	170	48	138	118	22	3	23	5	96	130	34	86	166	13	7
Total	734	4,533	5,601	979	3,214	3,379	5,49	223	Total	307	3,526	4,921	1,197	3,028	4,745	431	257
Percent.	3.7	23.0	28.4	6.0	16.4	19.6	2.8	1.1	Percent.	1.7	16.2	20.7	6.5	16.4	25.8	2.3	2.4

TABLE 2.—*Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhulst during 6-7 years—continued.*

SEPTEMBER.									OCTOBER.								
Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Hour.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
0	29	202	111	18	97	110	16	0	0	43	222	171	17	68	98	16	6
1	23	229	155	45	103	103	22	18	1	83	247	163	17	77	101	25	6
2	61	214	161	26	106	98	23	3	2	63	276	102	20	69	60	20	6
3	70	271	200	16	78	103	22	8	3	60	292	165	39	62	85	16	19
4	82	273	219	17	96	117	17	21	4	87	302	162	26	68	63	12	5
5	73	292	213	20	77	120	17	23	6	95	299	178	43	77	80	21	7
6	63	295	213	35	80	165	25	25	6	87	328	216	40	69	77	33	4
7	41	226	309	33	86	119	20	24	7	85	394	272	62	73	90	28	21
8	61	336	316	33	75	123	21	30	8	76	432	380	40	61	77	18	15
9	82	409	383	28	60	125	18	21	9	63	656	681	37	61	91	24	15
10	61	638	401	29	88	133	30	20	10	47	621	659	44	63	132	24	15
11	61	616	419	10	66	172	33	13	11	31	614	665	39	81	144	32	6
Neon	60	668	416	17	67	179	31	21	Neon	60	616	601	47	61	164	29	2
13	61	657	353	39	65	164	33	23	13	72	486	383	21	60	154	31	18
14	60	617	290	37	71	169	43	16	14	61	437	344	41	64	193	20	12
15	69	383	284	38	80	173	48	15	15	30	383	261	48	77	169	30	23
16	46	379	245	60	84	185	43	10	16	33	30	213	47	84	157	20	12
17	14	289	216	27	81	163	30	8	17	46	265	161	16	68	138	14	8
18	7	221	186	9	73	143	16	10	18	26	205	141	9	64	105	12	4
19	10	211	169	15	62	123	12	2	19	42	183	124	12	76	80	10	4
20	4	169	171	28	67	121	18	6	20	192	117	6	6	61	67	9	6
21	4	202	166	30	67	112	14	2	21	191	125	9	62	96	13	10	10
22	6	181	128	28	60	108	21	7	22	226	116	15	66	88	23	1	1
23	21	160	126	40	96	111	22	10	23	220	123	16	68	88	20	3	3
Total .	1,061	7,818	6,932	707	1,858	3,175	695	361	Total .	1,386	8,228	6,311	704	1,689	2,650	603	217
Per cent. .	4.9	36.4	27.6	3.3	6.6	1.8	2.8	1.7	Per cent. .	6.2	38.2	29.3	3.3	7.4	12.3	2.3	1.0

TABLE 2.—Number of miles recorded under each octant of the compass at each hour in each month of the year at Dhulri during 6-7 years—concluded.

NOVEMBER.										DECEMBER.									
Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.		Hour.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	
0	39	297	238	9	25	23	1	3		0	31	311	230	17	27	16	5	12	
1	34	330	229	10	17	23	1	3		1	45	341	238	12	31	17	7	4	
2	63	391	262	14	22	22	...	4		2	47	399	238	19	28	20	6	4	
3	64	415	252	23	25	20	...	6		3	68	455	263	13	38	25	7	7	
4	64	618	294	31	15	25	2	12		4	51	461	319	21	38	17	12	12	
5	70	667	317	25	22	31	2	11		5	59	513	338	16	43	21	12	12	
6	71	622	377	25	10	26	2	7		6	66	605	370	21	39	17	12	7	
7	82	744	469	30	28	23	6	5		7	67	665	436	19	37	20	10	6	
8	81	820	684	31	28	24	2	6		8	46	702	498	31	27	17	10	5	
9	46	1,334	916	53	19	28	4	2		9	47	1,099	704	33	32	15	2	14	
10	18	1,390	1,164	66	14	26	4	5		10	31	1,365	1,068	29	34	20	2	18	
11	16	1,243	1,277	84	12	23	...	...		11	12	1,330	1,174	20	28	28	6	8	
Noon.	12	1,088	1,179	17	19	20	...	...		Noon.	30	1,113	1,162	30	35	42	4	7	
13	22	883	1,015	12	30	20	...	...		13	...	927	1,098	34	30	38	12	3	
14	53	748	804	20	30	27	...	...		14	14	730	898	45	34	32	12	9	
15	60	695	651	15	47	23	6	4		15	21	648	657	32	44	32	15	7	
16	47	557	500	6	27	35	6	8		16	33	565	558	14	23	31	16	11	
17	43	394	363	7	26	23	2	3		17	17	436	434	12	17	19	14	16	
18	23	245	231	15	19	22	2	4		18	15	270	291	18	17	14	10	7	
19	18	206	177	6	27	20	2	5		19	22	213	235	15	16	18	9	10	
20	25	181	160	11	24	18	3	4		20	18	179	230	12	22	16	7	7	
21	28	194	164	12	23	19	4	3		21	21	181	201	13	30	17	6	8	
22	23	216	176	23	28	21	1	2		22	22	178	227	22	26	19	6	7	
23	24	266	217	19	27	17	1	3		23	27	244	230	19	31	28	7	9	
Total	1,022	14,163	12,006	508	573	558	60	100	Total	798	13,916	12,167	616	727	539	209	210		
Per cent.	35	48.9	41.4	1.7	2.0	1.9	0.2	0.3	Per cent.	2.7	47.9	41.8	1.8	2.5	1.8	0.7	0.7		

TABLE 3.—Number of miles recorded under each octant of the compass in each month of the year at Dhubri during 6-7 years.

Month.	Percentage . . . . .											
	Sum . . . . .											
January	919	8,580	6,370	932	913	2,811	1,052	169	21,806	218	17,407	33,231
February	586	3,570	4,607	608	1,109	4,911	1,708	218	17,407	163	33,231	44,136
March	932	8,487	8,577	621	2,711	8,673	2,717	463	33,231	692	44,136	38,691
April	2,030	17,169	16,282	1,016	2,890	4,280	818	692	44,136	612	38,691	21,787
May	2,187	17,063	13,316	1,316	1,619	1,684	604	612	38,691	328	21,787	19,742
June	664	6,615	8,831	1,111	766	2,713	436	328	21,787	223	19,742	18,412
July	731	4,333	6,601	979	3,244	3,879	619	223	19,742	301	21,807	28,975
August	307	3,526	4,921	1,197	3,028	4,745	431	257	18,412	503	21,807	29,096
September	1,061	7,818	5,932	707	1,858	3,176	695	301	21,807	100	28,975	3,10,338
October	1,336	8,228	6,311	704	1,699	2,050	503	217	21,648	10,222	11,163	12,000
November	1,022	11,163	12,000	503	673	558	50	100	28,975	210	29,096	3,10,338
December	703	13,943	12,137	616	727	639	209	210	29,096	100	28,975	3,10,338
	13,221	1,13,727	1,03,911	10,272	21,097	40,618	9,822	3,680	3,10,338	100	100	100

*Table 4.—Mean co-ordinates of the wind movement in each hour of each month at Dhauri as registered by a Beckley's anemograph from November 1889 to May 1896.*

Hour.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.		
Midnight to 1 .	+0.1	+0.9	-0.5	+0.1	-0.6	+0.7	+1.0	+4.0	+2.2	+4.3	+0.5	+2.7	-1.1	+1.0	-1.3	+0.9	-0.1	+1.5	+0.6	+1.3	+1.1	+2.1	+1.1	
1 to 2 .	+0.3	+1.0	-0.5	+0.1	+0.1	+1.4	+1.4	+4.4	+2.4	+4.6	+0.6	+2.8	-1.0	+1.1	-1.3	+0.9	+0.3	+1.6	+0.6	+1.7	+1.4	+2.5	+1.3	
2 to 3 .	+0.1	+1.0	-0.3	+0.3	+0.4	+2.1	+1.7	+4.3	+2.8	+4.6	+0.5	+3.1	-1.0	+1.1	-1.4	+0.7	+0.6	+1.8	+0.7	+1.8	+1.4	+2.6	+1.5	
3 to 4 .	+0.5	+1.3	-0.4	+0.7	+0.3	+2.2	+1.7	+4.3	+2.9	+4.6	+0.6	+3.1	-1.1	+1.7	-1.0	+0.9	+0.6	+2.1	+0.9	+1.7	+1.8	+2.1	+1.6	
4 to 5 .	+0.7	+1.3	-0.3	+0.7	+0.3	+2.2	+2.2	+5.1	+2.5	+4.2	+0.5	+2.9	-0.6	+2.0	-0.9	+1.1	+0.7	+2.1	+0.8	+1.8	+2.0	+2.2	+1.7	
5 to 6 .	+0.8	+1.6	-0.4	+1.0	+0.3	+2.4	+2.7	+5.4	+3.0	+4.7	+0.8	+3.6	-0.7	+2.3	-0.8	+1.4	+0.7	+2.2	+0.9	+2.1	+2.2	+2.9	+2.0	
6 to 7 .	+1.0	+1.8	-0.4	+0.8	+0.9	+3.2	+2.6	+6.3	+2.7	+4.0	+0.8	+3.0	-0.3	+2.8	-1.1	+3.2	+0.9	+2.7	+1.1	+2.0	+2.7	+4.7	+2.2	
7 to 8 .	+1.0	+2.1	-0.4	+1.0	+0.9	+3.8	+3.2	+6.9	+2.0	+5.1	+1.1	+4.4	-0.4	+3.0	-0.7	+2.2	+0.8	+2.7	+1.4	+3.5	+2.8	+5.6	+2.3	
8 to 9 .	+1.4	+3.7	-0.3	+2.1	+0.9	+5.3	+3.3	+8.4	+3.1	+6.7	+1.3	+5.1	+0.1	+3.0	-0.6	+2.6	+1.3	+3.5	+1.7	+4.9	+4.0	+6.8	+3.5	
9 to 10 .	+2.3	+5.2	+0.3	+3.6	+0.8	+5.3	+3.2	+9.1	+2.0	+7.2	+1.4	+5.0	+0.2	+3.6	-0.4	+2.7	+1.6	+3.9	+1.4	+4.8	+4.0	+7.0	+4.2	
10 to 11 .	+2.0	+5.6	+0.4	+3.8	+0.2	+4.4	+2.0	+8.7	+2.7	+6.9	+1.4	+5.2	+0.5	+3.4	-0.8	+2.1	+1.7	+3.0	+1.2	+4.1	+3.5	+6.3	+3.4	
11 to Noon .	+1.5	+5.3	0.0	+2.5	-0.7	+2.7	+2.1	+7.4	+2.0	+6.6	+0.8	+4.6	+0.1	+2.6	-1.3	+1.6	+1.6	+3.7	+1.3	+3.2	+2.8	+5.8	+2.7	
Noon to 13 .	+1.2	+3.6	-0.8	+0.7	-1.8	+0.8	+1.4	+6.1	+2.7	+5.4	+0.5	+4.4	-0.3	+1.4	-1.7	+1.0	+1.4	+3.1	+0.8	+2.8	+2.5	+5.3	+2.1	
13 to 14 .	+0.7	+2.8	-1.3	-0.2	-3.0	-0.7	+0.7	+4.6	+1.8	+5.4	+0.5	+4.4	-0.3	+1.4	-1.7	+1.0	+1.4	+3.1	+0.8	+2.8	+2.5	+5.3	+2.1	
14 to 15 .	+0.3	+1.8	-1.4	-1.0	-2.4	-1.0	-3.4	+3.0	+1.7	+5.0	-0.2	+3.8	-0.9	+0.0	-2.1	+0.5	+0.7	+2.4	+0.5	+2.1	+2.0	+5.0	+1.0	
15 to 16 .	+0.1	+1.2	-1.5	-1.2	-2.4	-2.7	0.0	+3.1	+1.4	+4.5	-0.4	+2.8	-1.3	-0.8	-1.9	+0.3	+0.5	+2.2	+0.3	+1.3	+1.3	+4.0	+1.4	
16 to 17 .	+0.3	+1.0	-1.0	-1.1	+1.4	-2.1	+0.0	+3.7	+1.0	+4.3	-0.4	+2.6	-1.6	+0.5	-1.8	+0.4	0.0	+1.7	+0.2	+1.1	+0.8	+3.9	+0.8	
17 to 18 .	+0.3	+0.9	-0.4	-0.4	-0.6	-1.2	+0.0	+3.8	+1.8	+4.3	-0.5	+2.5	-1.5	+0.4	-1.6	+0.5	0.0	+1.4	+0.2	+1.1	+0.6	+3.5	+0.7	
18 to 19 .	+0.3	+0.7	-0.2	-0.3	-0.1	-0.3	+1.3	+4.1	+1.7	+4.1	-0.2	+2.3	-1.7	+0.4	-1.1	+0.5	-0.1	+1.2	+0.3	+1.1	+0.5	+3.3	+0.5	
19 to 20 .	+0.4	+0.8	-0.3	-0.3	+0.1	-0.2	+1.8	+3.9	+1.6	+4.3	0.0	+2.0	-1.3	+0.6	-1.0	+0.8	-0.3	+1.2	+0.4	+1.1	+0.5	+3.3	+0.5	
20 to 21 .	+0.3	+0.6	0.0	-0.1	-0.2	+0.3	+1.1	+4.5	+1.4	+4.2	-0.2	+2.0	-1.4	+1.2	-1.1	+0.5	-0.1	+1.4	+0.3	+1.0	+0.6	+3.1	+0.5	
21 to 22 .	+0.1	+0.6	-0.2	0.0	-0.7	0.0	+1.9	+3.8	+1.6	+3.0	-0.1	+2.0	-1.0	+1.3	-1.2	+0.6	-0.1	+1.1	+0.4	+1.1	+0.6	+3.1	+0.5	
22 to 23 .	+0.2	+0.7	-0.6	0.0	-1.1	+0.2	+1.3	+3.9	+1.7	+3.7	0.0	+2.1	-1.0	+1.1	-1.0	+0.6	-0.2	+1.1	+0.4	+1.1	+0.8	+1.9	+0.7	
23 to Midnight .	+0.3	+0.6	-0.4	0.0	-0.9	+0.3	+1.4	+3.7	+2.0	+3.7	+0.3	+2.1	-0.0	+1.0	-1.1	+0.9	-0.2	+1.1	+0.3	+1.4	+1.0	+2.1	+1.0	
TOTAL .	+10.6	+49.1	-10.5	+12.7	-0.6	+27.7	+41.1	+133.6	+64.2	+117.6	+0.7	+70.6	-17.3	+41.6	-27.5	+27.5	+13.6	+53.6	+18.0	+54.5	+45.6	+104.1	+43.2	
Mean of day .	+0.7	+1.0	-0.4	+0.6	-0.4	+1.2	+1.7	+5.2	+2.3	+4.0	+0.4	+3.3	-0.7	+1.7	-1.1	+1.2	+0.6	+2.2	+0.8	+2.2	+1.9	+4.3	+1.8	

N. and E. are treated as positive; S. and W. as negative values.



TABLE 5.—Hourly co-ordinates of the mean diurnal variation of wind movement at Dhubbri from 6-7 years' registers of a Beekley's anemometer. East and North are designated by +, South and West by — sign.

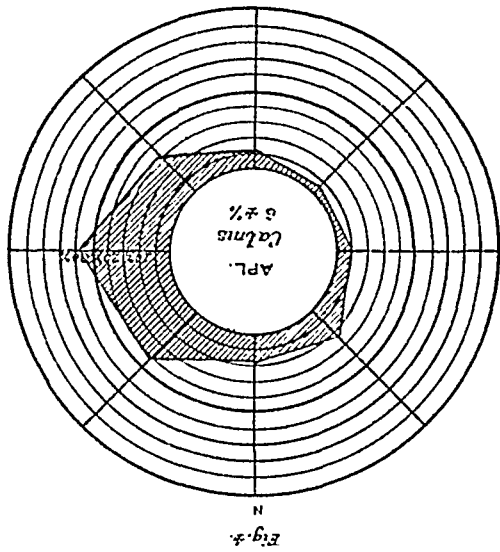
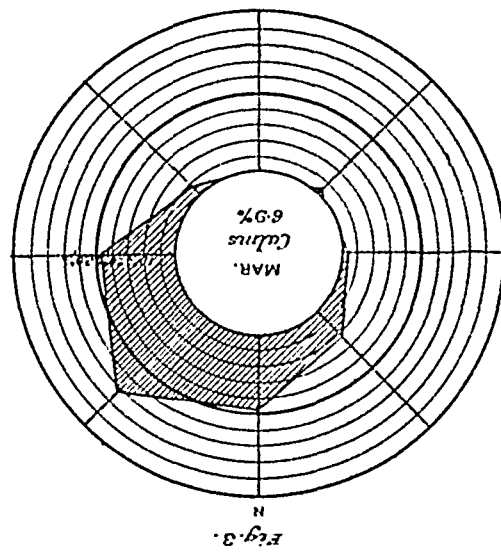
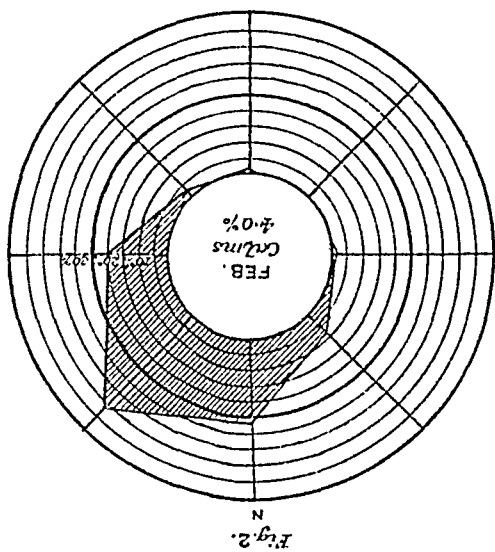
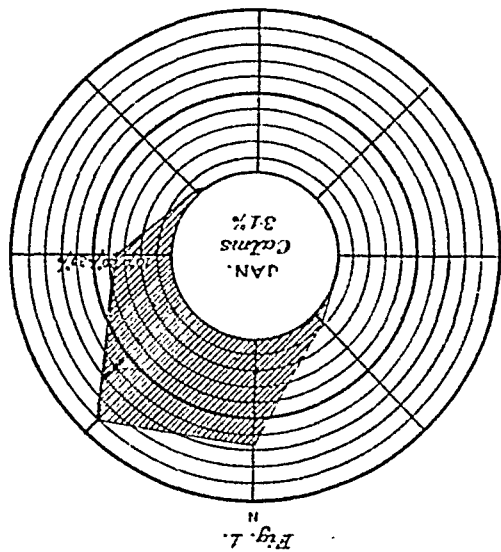
Hour.	North and South COMPONENT.		East and West COMPONENT.	
	Observed.	Observed.	Observed.	Observed.
Midnight to 1.	.	—0.3	—0.9	—0.9
1 to 2.	.	—0.3	—0.8	—0.8
2 to 3.	.	0.0	—0.6	—0.6
3 to 4.	.	+0.1	—0.4	—0.4
4 to 5.	.	+0.2	—0.3	—0.3
5 to 6.	.	+0.3	+0.1	+0.1
6 to 7.	.	+0.5	+0.6	+0.6
7 to 8.	.	+0.6	+1.0	+1.0
8 to 9.	.	+1.0	+2.3	+2.3
9 to 10.	.	+1.3	+3.3	+3.3
10 to 11.	.	+1.1	+3.0	+3.0
11 to Noon	.	+0.8	+2.4	+2.4
Noon to 13.	.	+0.3	+1.1	+1.1
13 to 14.	.	—0.2	+0.4	+0.4
14 to 15.	.	—0.6	—0.4	—0.4
15 to 16.	.	—0.8	—1.0	—1.0
16 to 17.	.	—0.6	—1.3	—1.3
17 to 18.	.	—0.6	—1.8	—1.8
18 to 19.	.	—0.6	—1.3	—1.3
19 to 20.	.	—0.4	—1.3	—1.3
20 to 21.	.	—0.3	—1.3	—1.3
21 to 22.	.	—0.5	—1.3	—1.3
22 to 23.	.	—0.5	—1.2	—1.2
23 to Midnight	.	—0.1	—1.2	—1.2

# APPENDIX.

TABLE 6.—*Mean movement of air irrespective of direction in each hourly interval of each month as registered by a Beckley's anemograph at Dhulri from November 1889 to May 1896.*

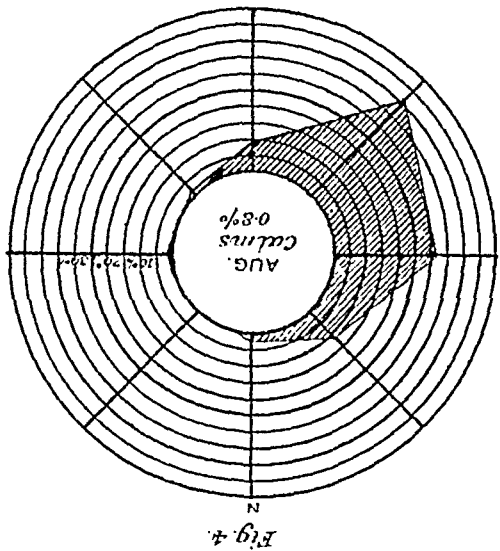
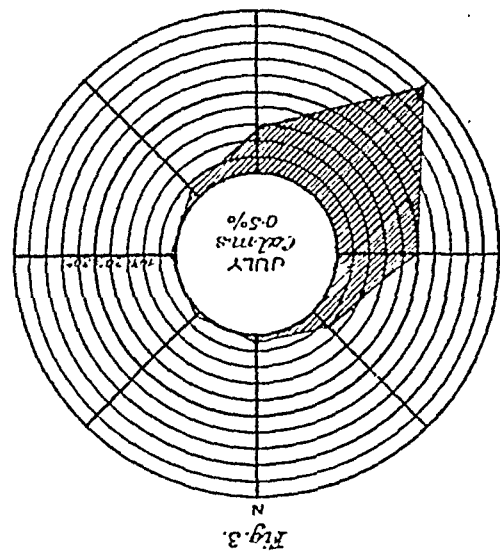
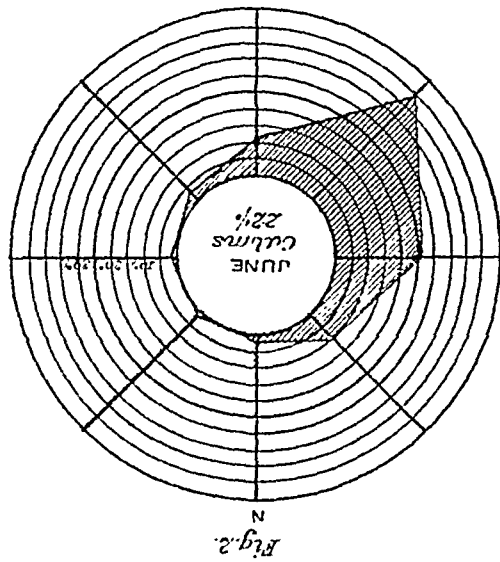
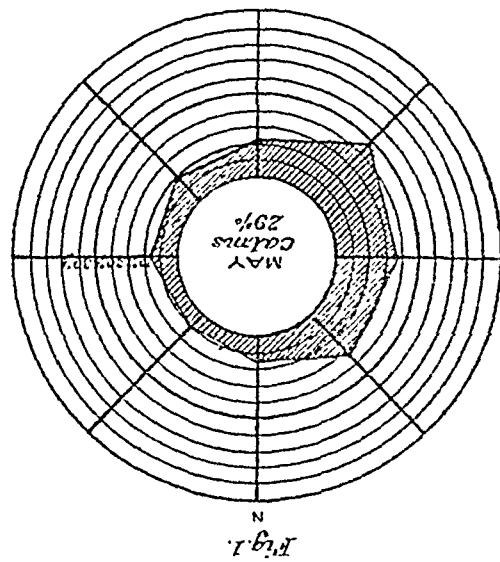
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Midnight to 1 .	2.9	3.5	5.7	8.3	7.5	5.1	5.1	4.0	4.2	3.8	3.1	3.3	4.7
1 " 2 .	3.1	3.7	6.3	8.7	7.6	5.5	5.5	4.6	4.3	3.9	3.6	3.6	5.0
2 " 3 .	3.2	3.8	7.0	8.3	8.0	5.4	5.6	4.6	4.6	4.0	3.8	4.1	5.2
3 " 4 .	3.5	4.3	6.9	8.6	8.5	5.9	6.5	4.6	5.2	4.0	4.6	4.4	5.6
4 " 5 .	3.5	4.7	6.7	8.7	8.3	5.0	6.1	4.8	5.2	4.3	5.0	4.8	5.7
5 " 6 .	3.7	5.0	7.0	9.3	8.7	6.0	6.5	5.0	5.2	4.6	5.5	5.4	6.0
6 " 7 .	4.0	4.5	7.6	10.3	8.8	6.6	6.7	5.7	5.9	5.5	6.7	5.9	6.5
7 " 8 .	4.3	4.9	8.7	10.6	8.8	7.1	6.1	5.6	6.2	6.2	7.6	6.4	6.9
8 " 9 .	6.2	6.6	9.6	12.2	10.2	8.3	7.2	5.8	6.8	7.8	11.0	9.2	8.4
9 " 10 .	8.4	9.1	10.3	12.8	11.0	8.7	7.6	6.4	7.8	8.7	12.8	12.2	9.7
10 " 11 .	8.3	9.0	9.8	12.5	10.6	8.3	7.3	6.2	8.1	8.2	12.4	12.4	9.4
11 " Noon	7.8	7.6	8.5	11.7	11.0	9.2	7.1	6.0	8.2	7.4	11.2	11.5	8.9
Noon " 13 .	6.8	5.7	7.7	11.3	10.5	8.8	6.6	6.3	7.9	6.7	9.5	10.1	8.1
13 " 14 .	6.1	5.8	8.3	11.2	9.4	8.6	6.0	6.0	7.2	6.2	8.0	8.4	7.6
14 " 15 .	5.3	5.6	8.3	11.0	9.1	8.0	6.2	6.0	6.6	5.5	6.7	6.9	7.1
15 " 16 .	4.8	5.3	8.1	10.7	8.7	7.0	5.5	5.7	6.4	4.8	5.7	6.1	6.6
16 " 17 .	3.4	4.3	7.4	10.4	8.2	6.3	4.9	4.6	5.1	3.8	4.1	4.6	5.7
17 " 18 .	2.6	2.9	5.8	8.9	7.6	5.8	4.5	4.6	4.2	3.0	2.7	3.1	4.6
18 " 19 .	2.5	2.6	4.7	8.1	7.4	4.9	4.3	3.5	3.7	2.9	2.2	2.5	4.1
19 " 20 .	2.4	2.5	5.0	8.2	7.1	4.2	4.0	3.6	3.5	2.7	2.0	2.3	4.0
20 " 21 .	2.5	3.1	5.0	7.8	7.0	4.1	4.6	3.7	3.6	2.9	2.1	2.3	4.1
21 " 22 .	2.6	3.1	5.3	8.1	6.9	4.6	4.4	3.8	3.3	3.0	2.4	2.4	4.2
22 " 23 .	2.6	3.6	5.1	7.6	6.9	4.7	4.5	3.4	3.7	3.2	2.8	2.8	4.3
23 " Midnight	2.6	3.5	5.4	7.4	7.1	4.8	5.0	3.7	3.7	3.5	3.0	3.1	4.4
Total daily .	103.3	114.5	170.1	232.7	204.9	153.8	137.5	113.9	130.5	116.4	133.7	137.9	146.6
Mean hourly .	4.3	4.8	7.1	9.7	8.5	6.4	5.7	5.0	5.4	4.9	5.3	5.8	6.1

WIND ROSES SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS DURING THE MONTHS OF JANUARY TO APRIL AT PORT BLAIR.





WIND ROSES SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS DURING THE MONTHS OF MAY TO AUGUST AT PORT BLAIR.





WIND ROSES SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS DURING THE MONTHS OF SEPTEMBER TO DECEMBER AND THE YEAR AT PORT BLAIR.

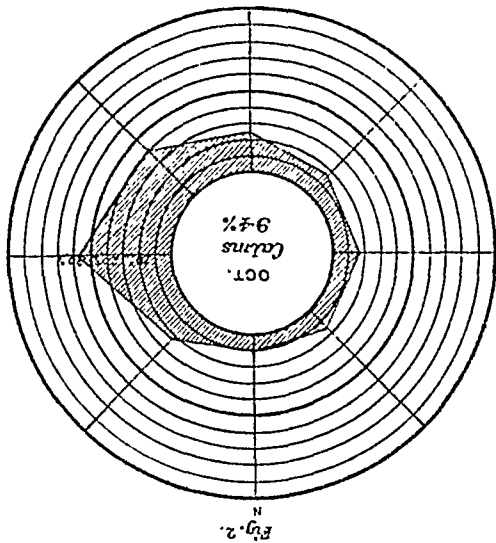


Fig. 2.

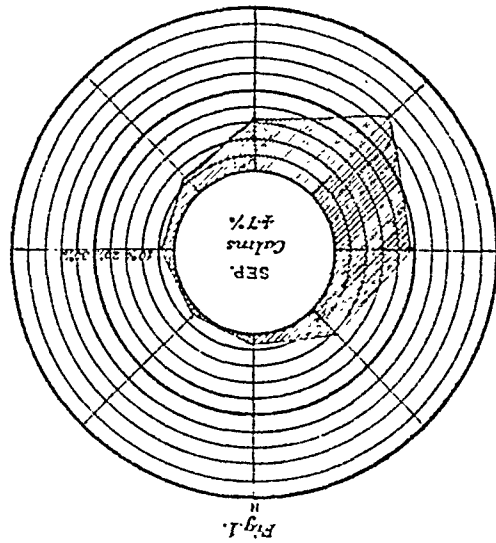


Fig. 1.

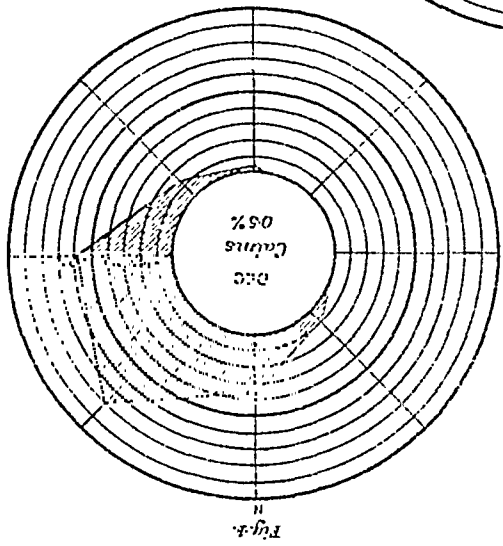


Fig. 4.

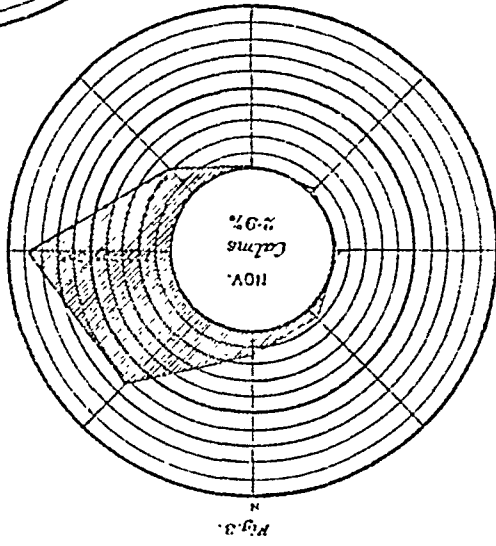


Fig. 3.

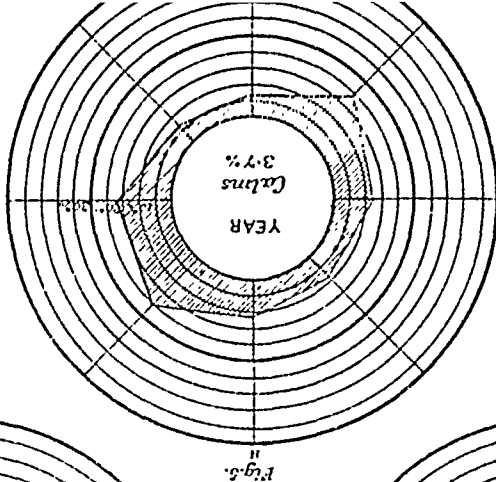
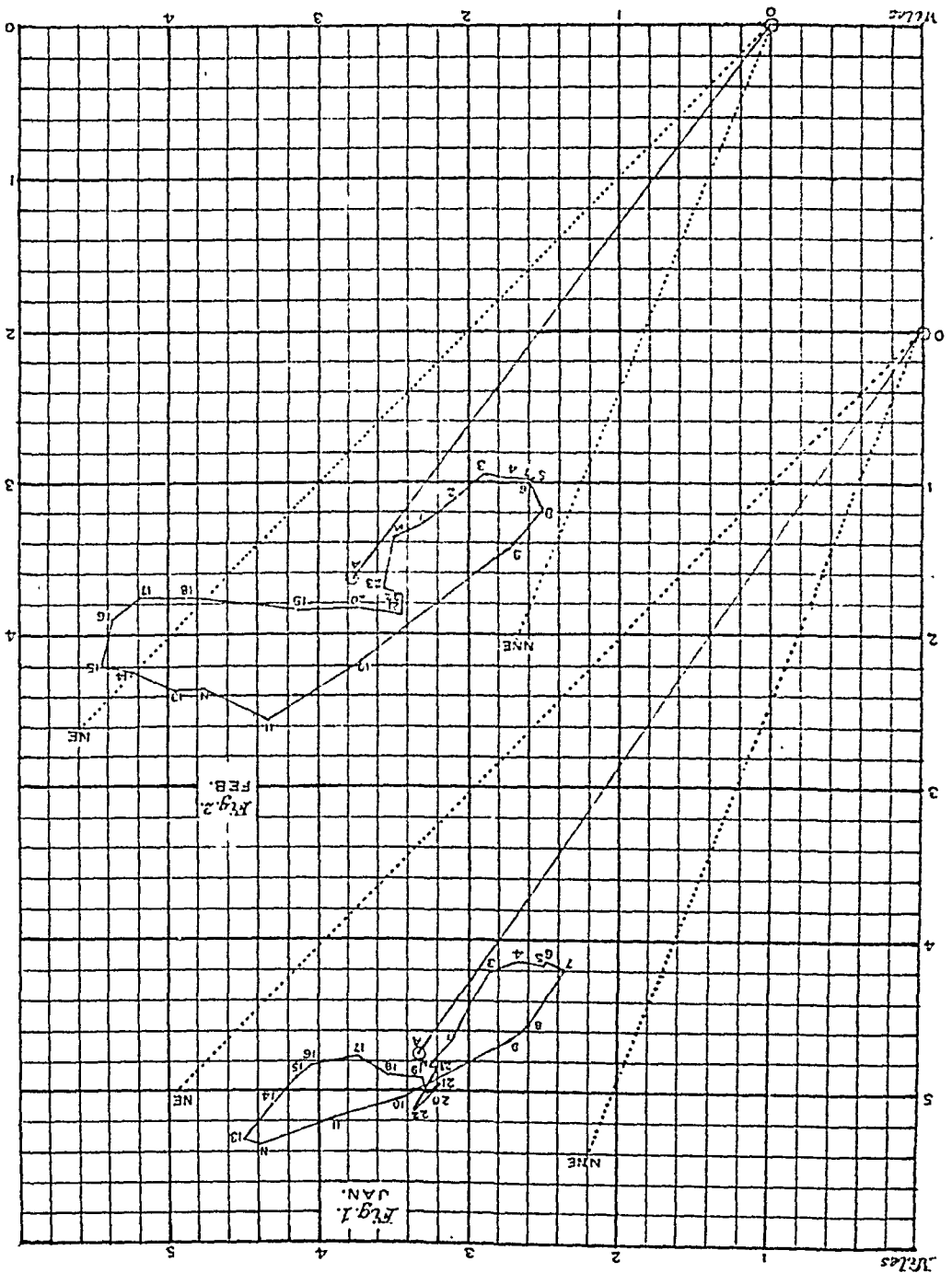


Fig. 5.



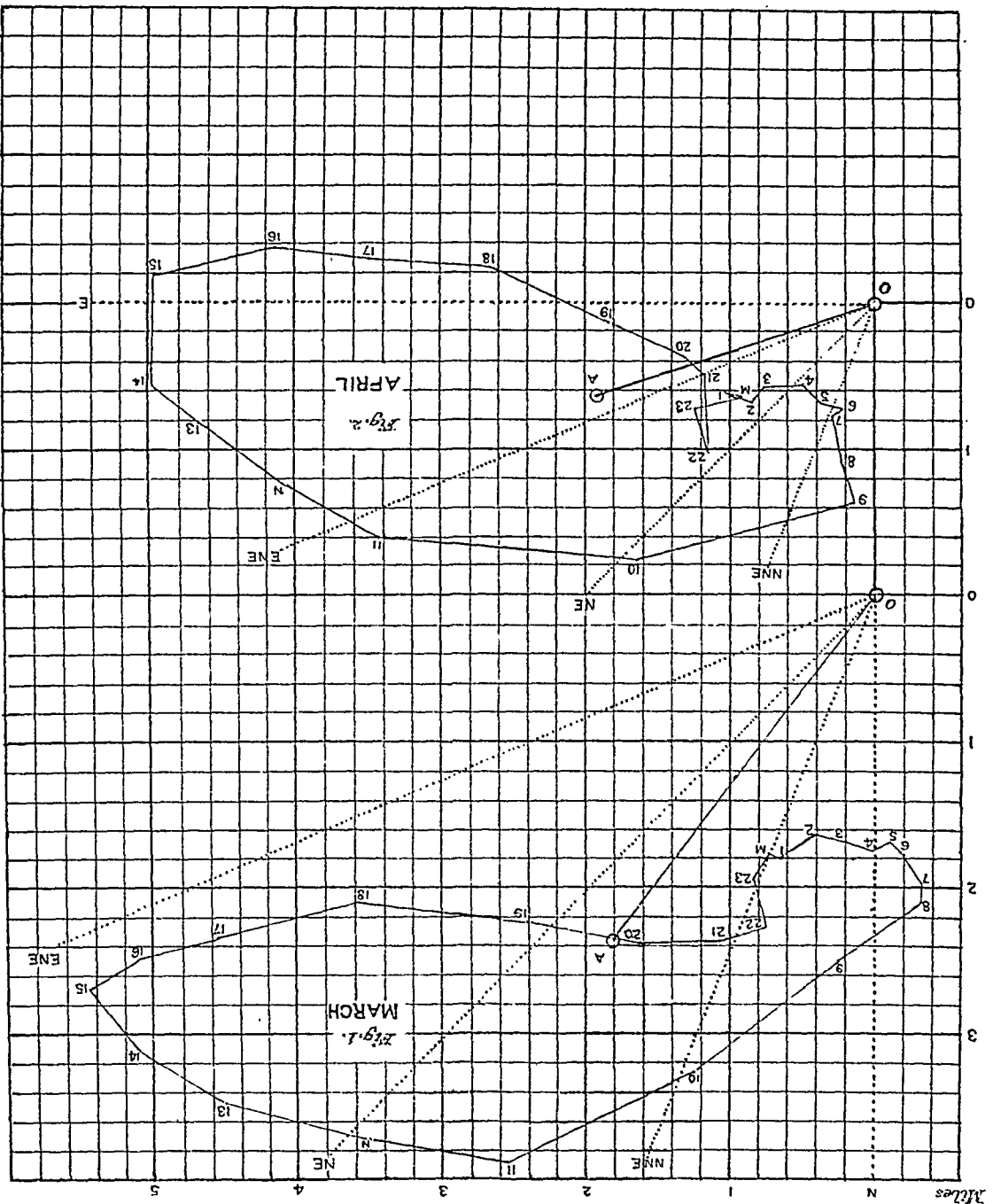


MEAN DIURNAL VARIATION OF THE WIND AT PORT BLAIR IN JANUARY AND FEBRUARY  
SHOWING THE RESULTANT AIR MOVEMENT DURING SUCCESSIVE HOURS.



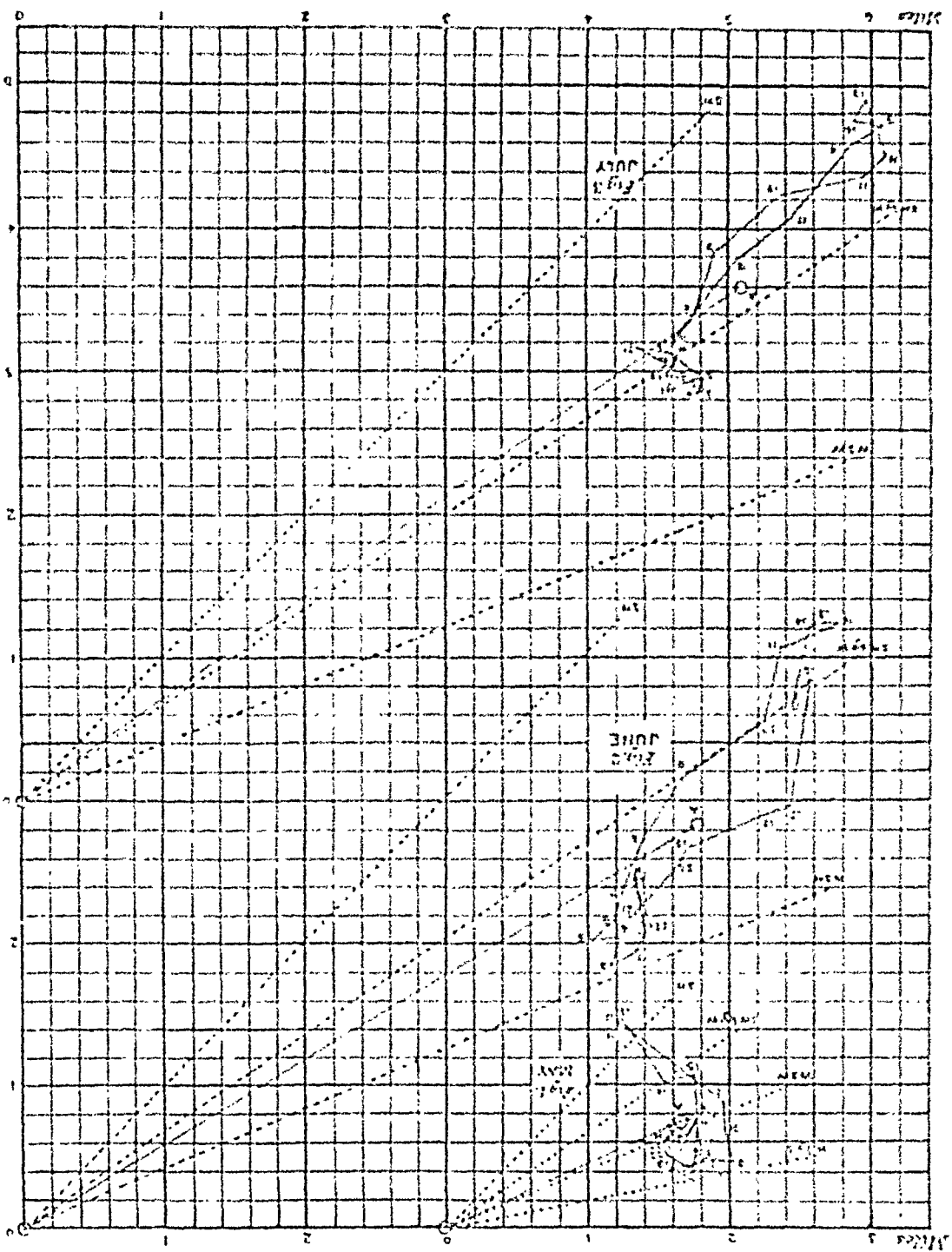


MEAN DIURNAL VARIATION OF THE WIND AT PORT BLAIR IN MARCH AND APRIL SHOWING THE RESULTANT AIR MOVEMENT DURING SUCCESSIVE HOURS.



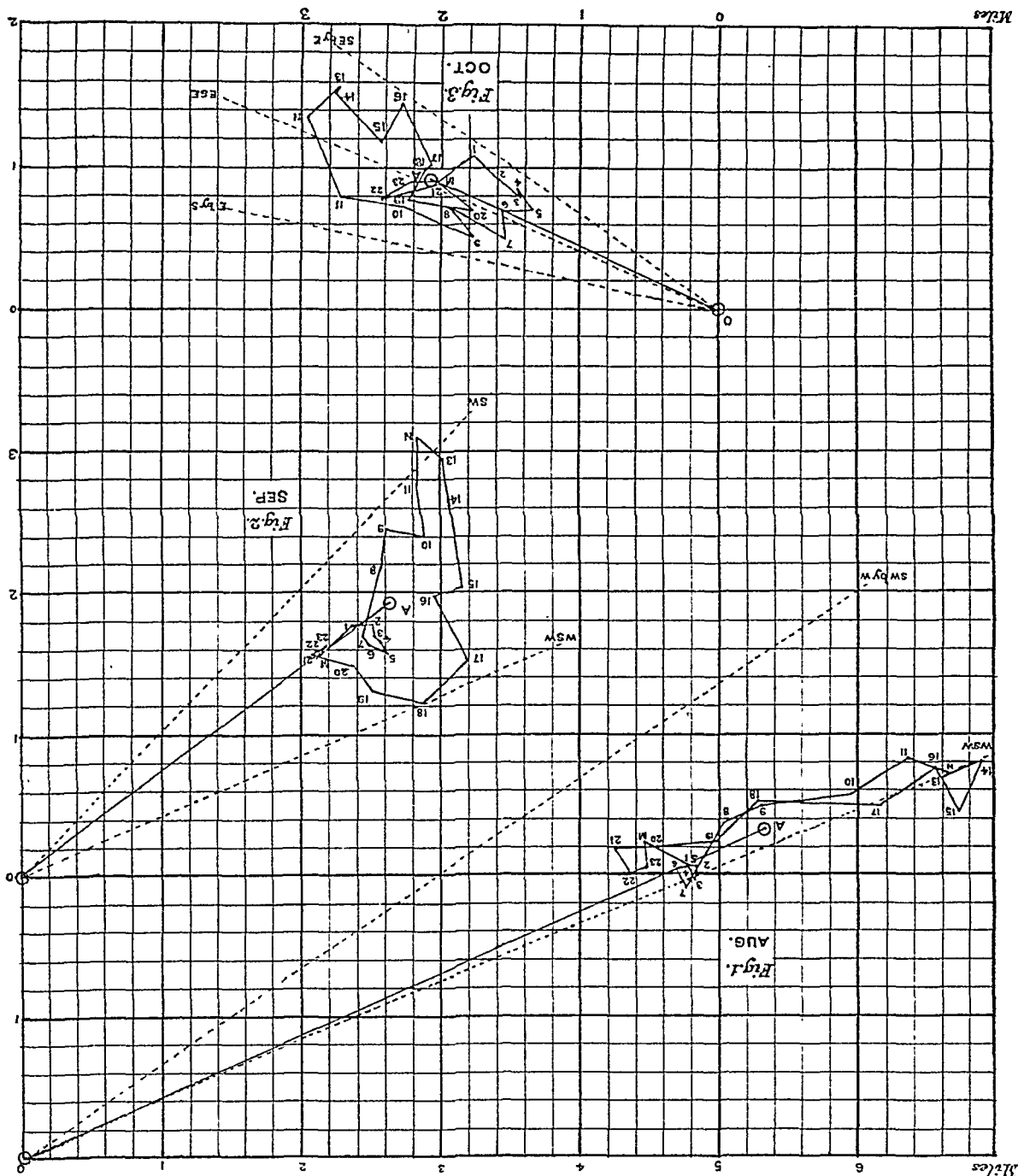


MEAN DIURNAL VARIATION OF THE WIND AT PORT BLAIR IN MAY, JUNE AND JULY  
SHOWING THE RESULTANT AIR MOVEMENT DURING SUCCESSIVE HOURS.





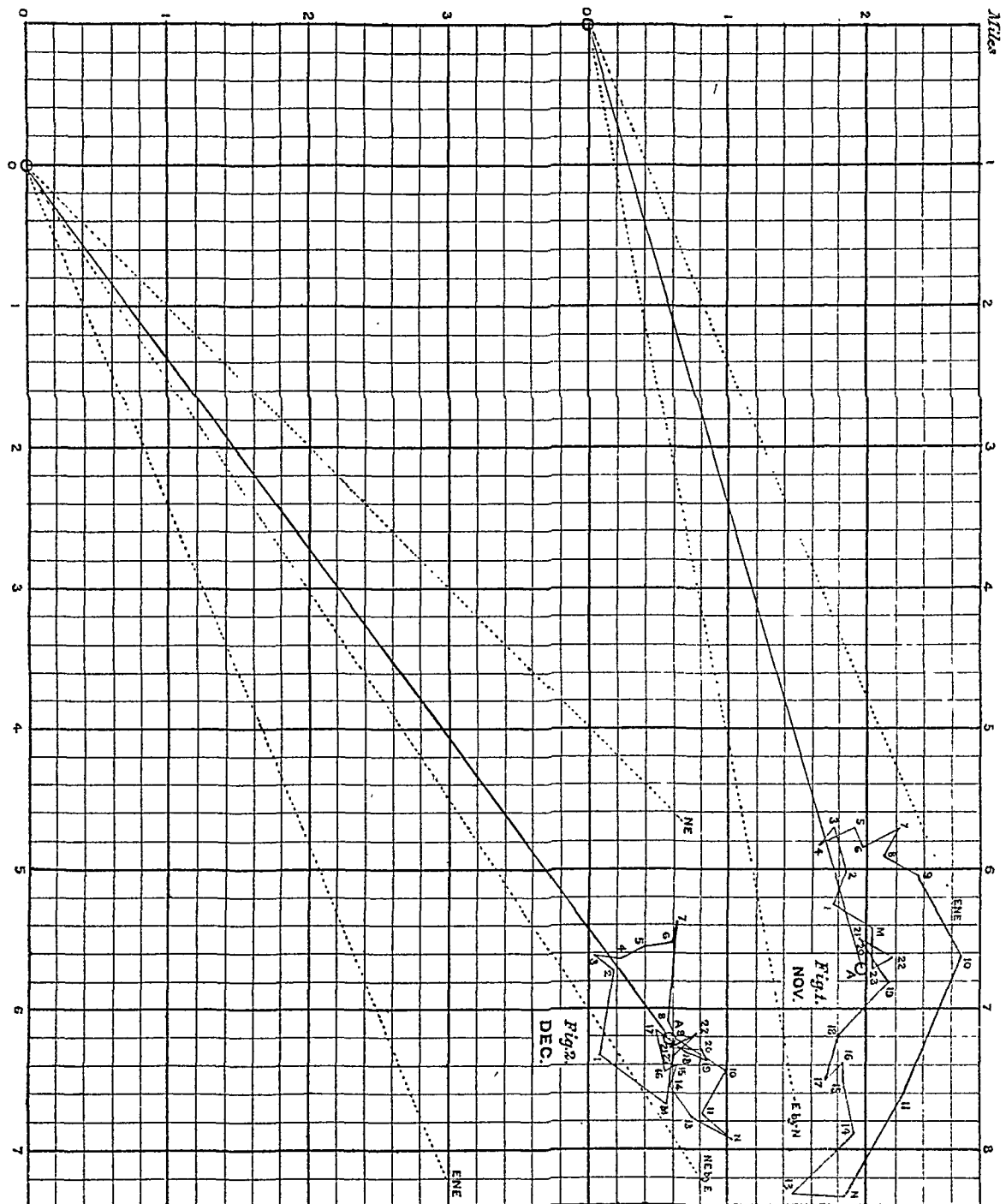
MEAN DIURNAL VARIATION OF THE WIND AT PORT BLAIR IN AUGUST, SEPTEMBER AND OCTOBER,  
SHOWING THE RESULTANT AIR MOVEMENT DURING SUCCESSIVE HOURS.





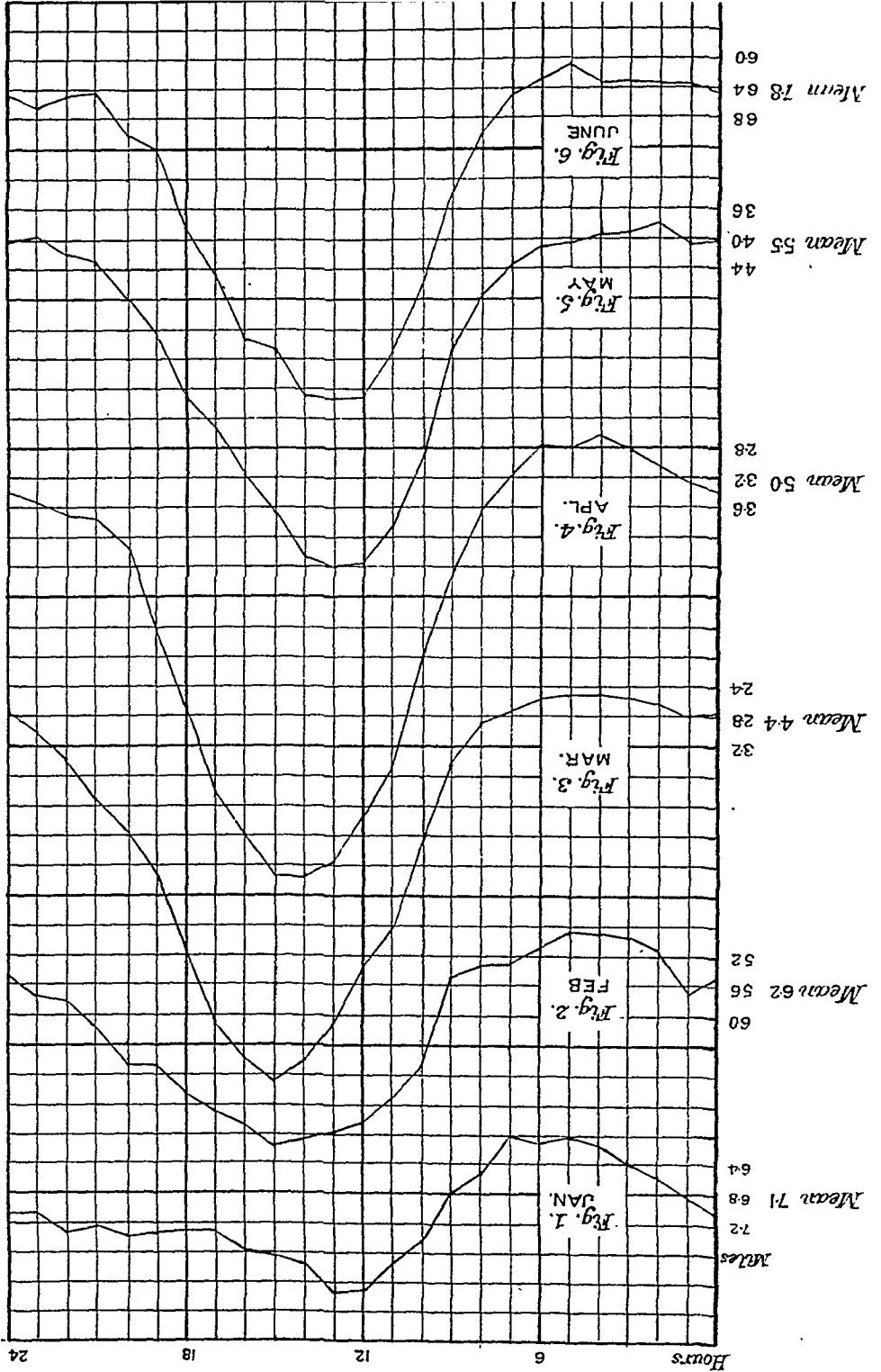


MEAN DIURNAL VARIATION OF THE WIND AT PORT BLAIR IN NOVEMBER AND DECEMBER, SHOWING  
THE RESULTANT AIR MOVEMENT DURING SUCCESSIVE HOURS.



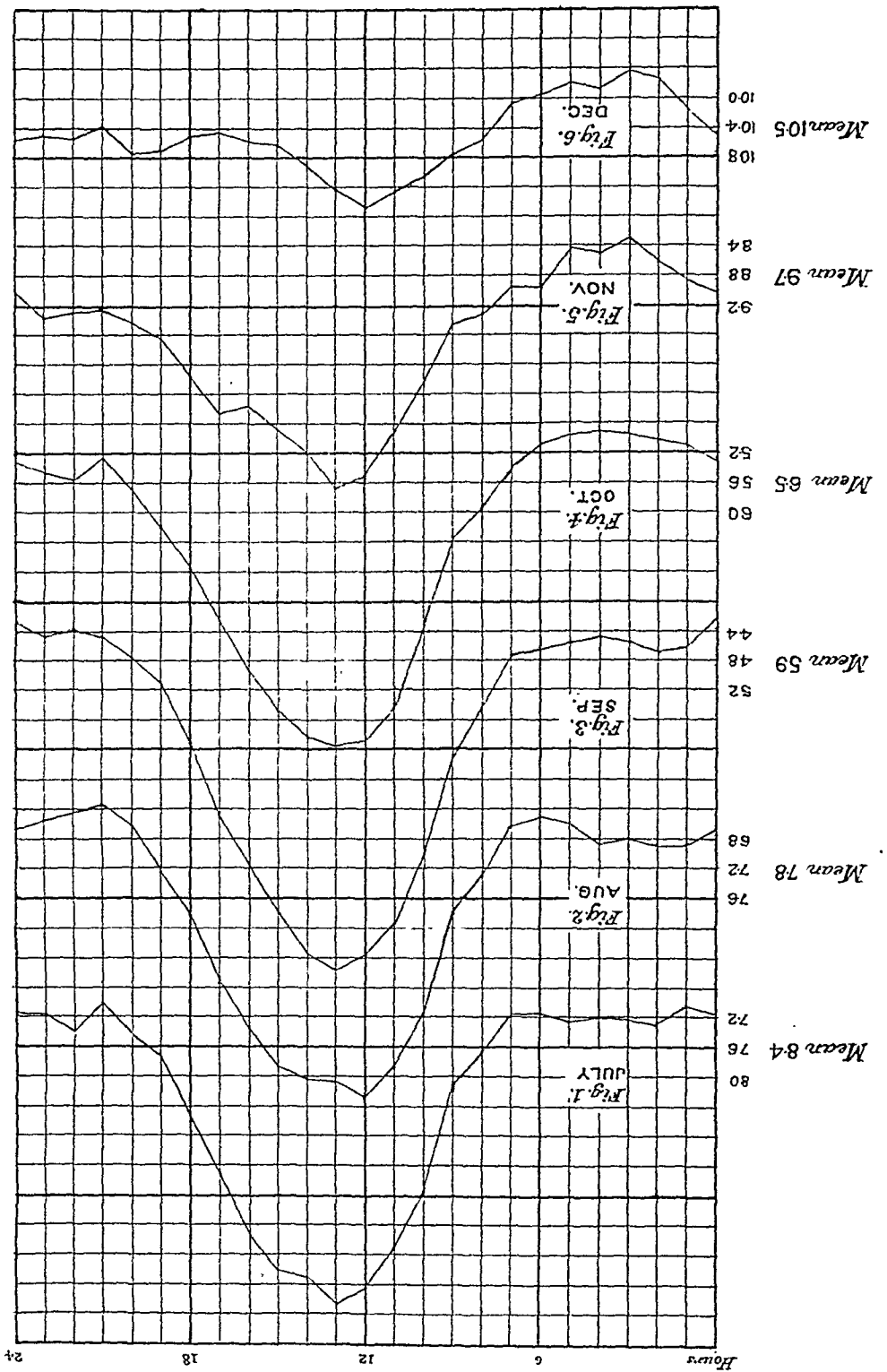


MEAN DIURNAL VARIATION OF THE WIND VELOCITY AT PORT BLAIR FOR THE MONTHS JANUARY TO JUNE SHOWING THE TOTAL AIR MOVEMENT IRRESPECTIVE OF DIRECTION DURING SUCCESSIVE HOURS.



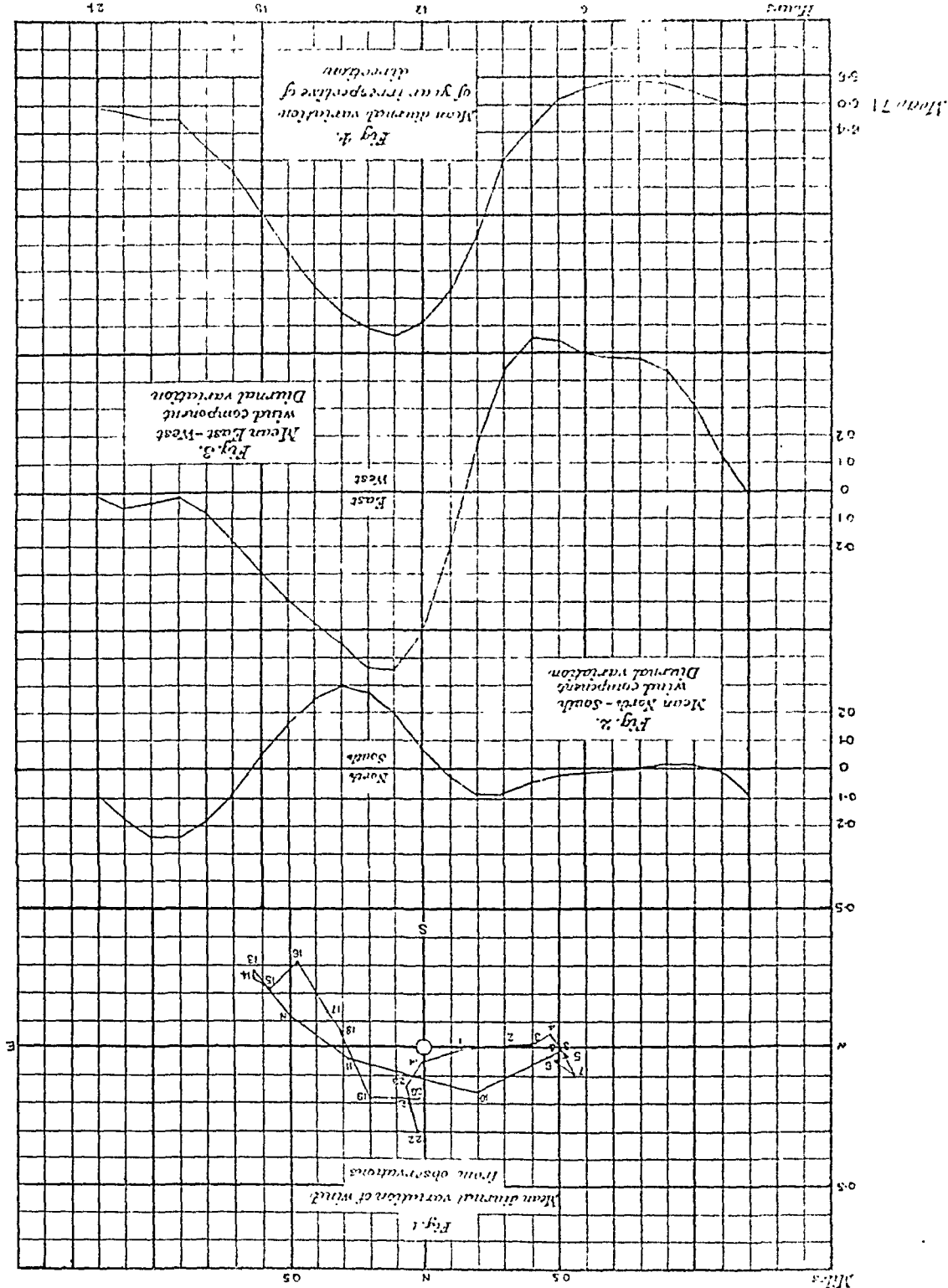


MEAN DIURNAL VARIATION OF THE WIND VELOCITY AT PORT BLAIR FOR THE MONTHS JULY TO DECEMBER SHOWING THE TOTAL AIR MOVEMENT IRRESPECTIVE OF DIRECTION DURING SUCCESSIVE HOURS.





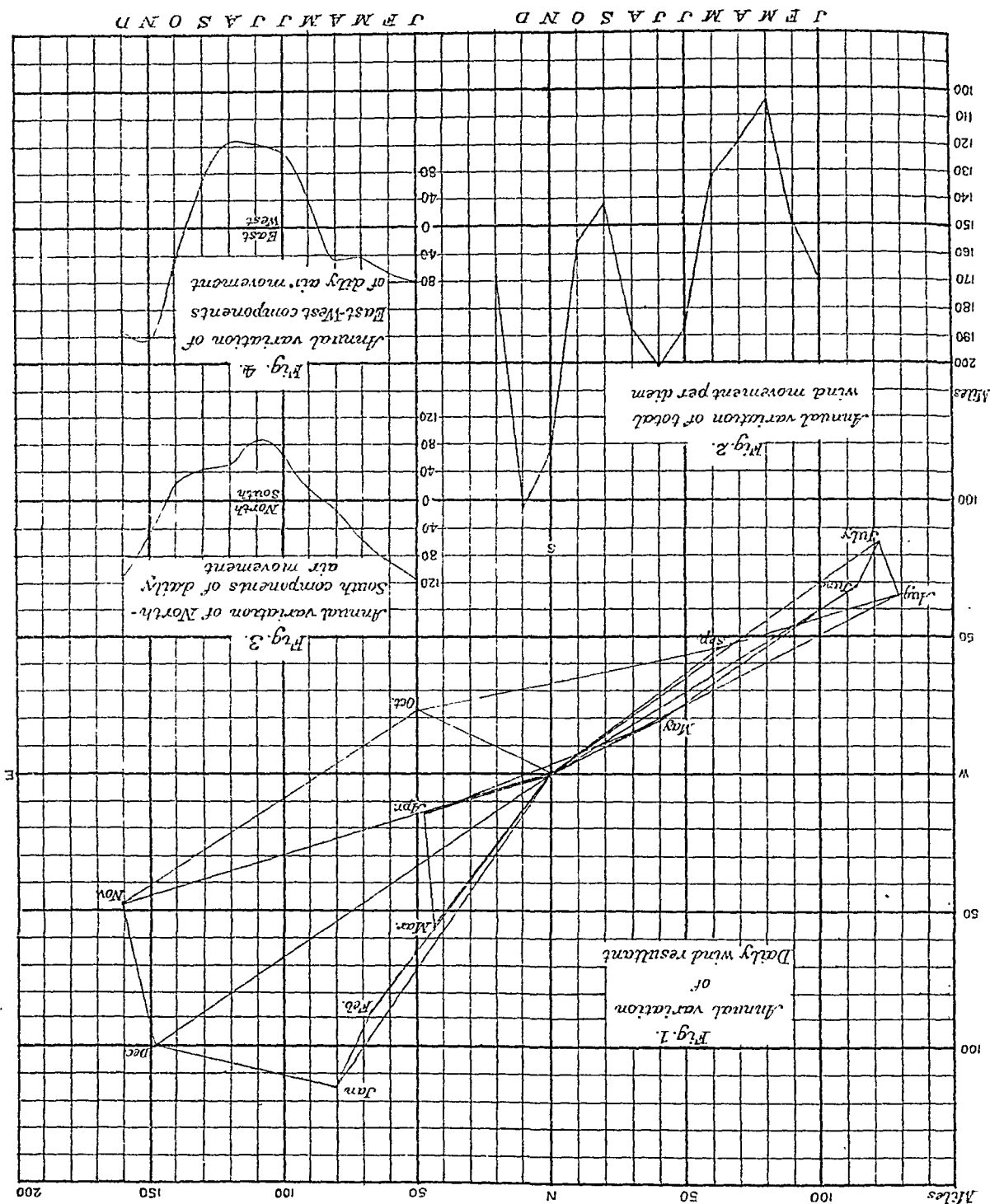
MEAN FOR THE YEAR OF (1) THE DAILY VARIATION OF RESULTANT AIR MOVEMENTS DURING SUCCESSIVE HOURS, (2) THE NORTH-SOUTH COMPONENTS AND (3) THE EAST-WEST COMPONENTS OF THE RESULTANT WIND MOVEMENTS, ALSO (+) OF THE WIND MOVEMENT IRRESPECTIVE OF DIRECTION DURING SUCCESSIVE HOURS OF THE DAY.





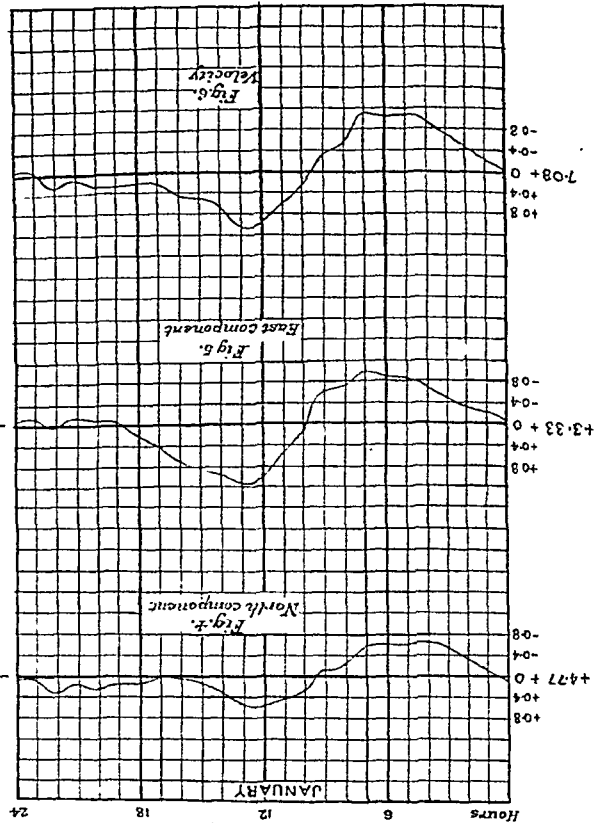
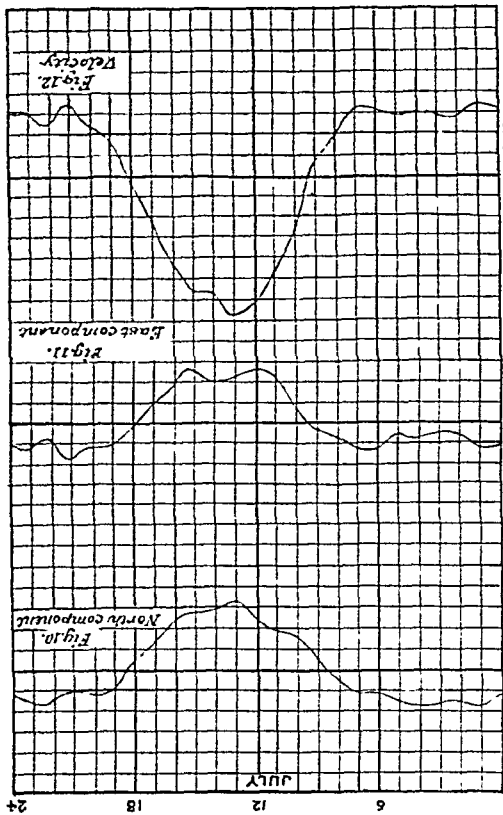
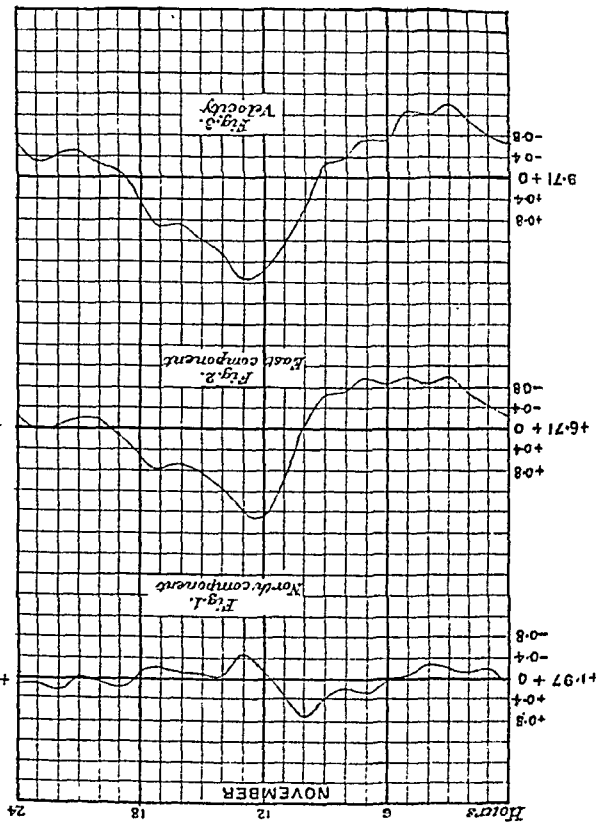
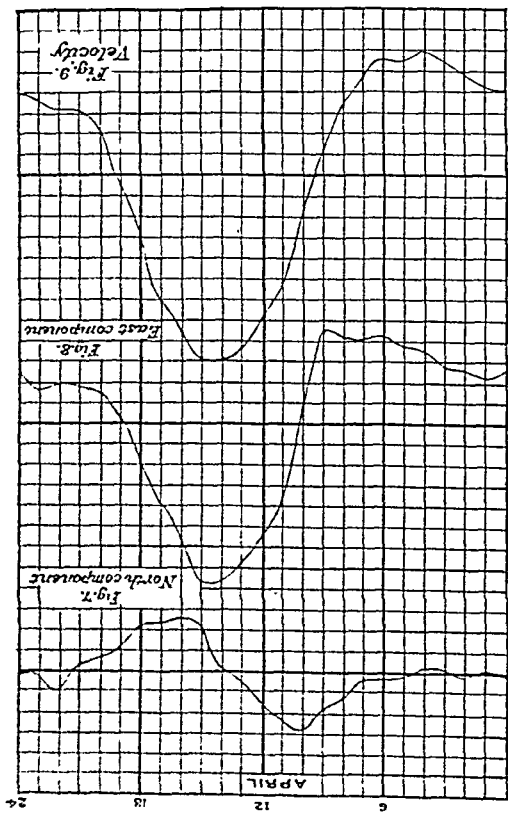


ANNUAL VARIATION &c MEANS FOR THE DIFFERENT MONTHS OF THE YEAR, OF (1) THE DAILY RESULTANT AIR MOVEMENT, (2) THE TOTAL DAILY AIR MOVEMENT IRRESPECTIVE OF DIRECTION, (3) THE NORTH-SOUTH COMPONENTS OF THE RESULTANT DAILY AIR MOVEMENT, AND (4) THE EAST-WEST COMPONENTS OF THE SAME.



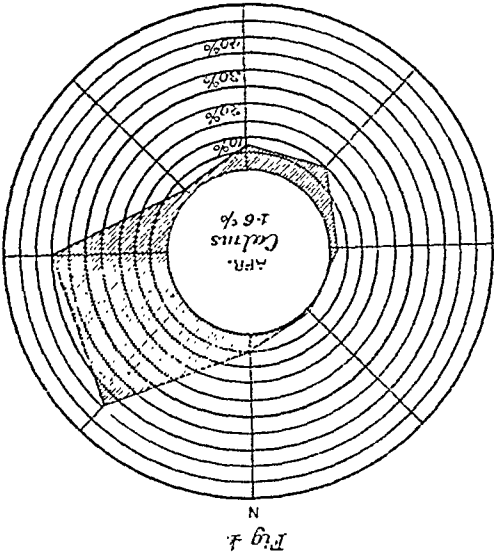
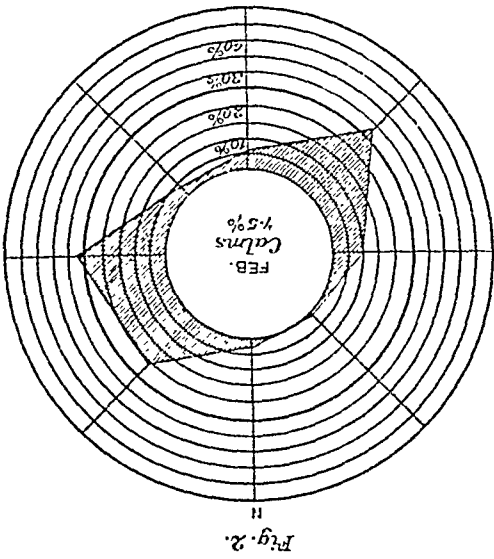
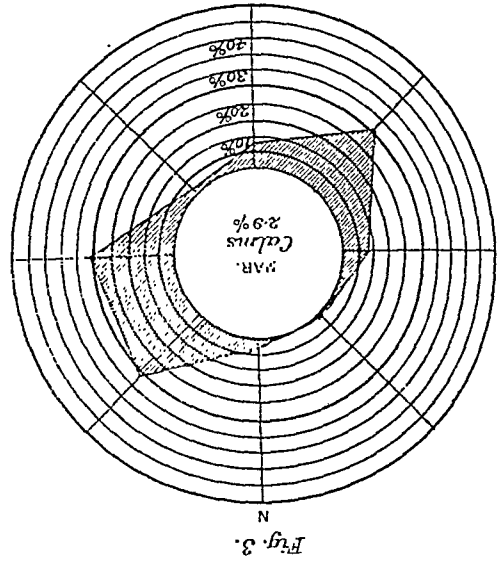
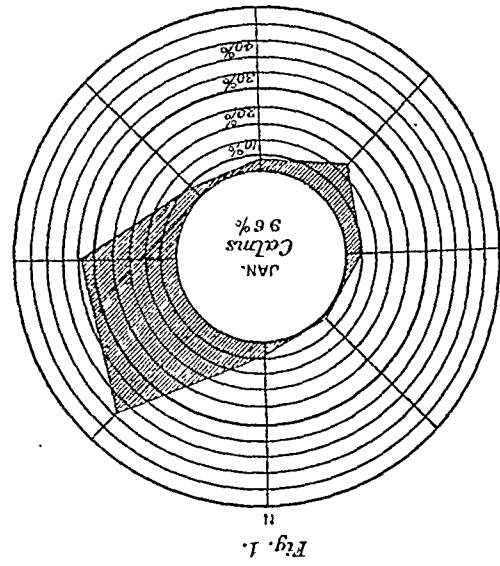


MEAN DIURNAL VARIATION OF NORTH-SOUTH AND EAST-WEST COMPONENTS OF THE RESULTANT AIR MOVEMENT, AND THE TOTAL AIR MOVEMENT IRRESPECTIVE OF DIRECTION DURING SUCCESSIVE HOURS AT PORT BLAIR FOR NOVEMBER, JANUARY, APRIL AND JULY.



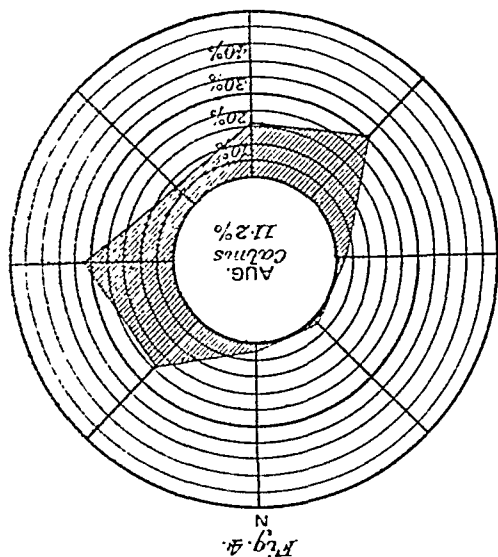
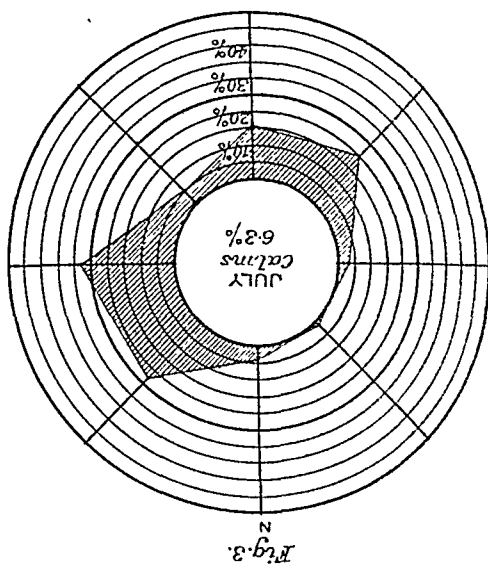
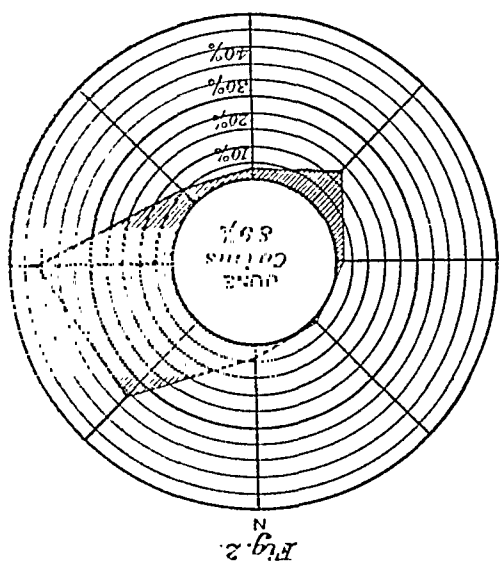
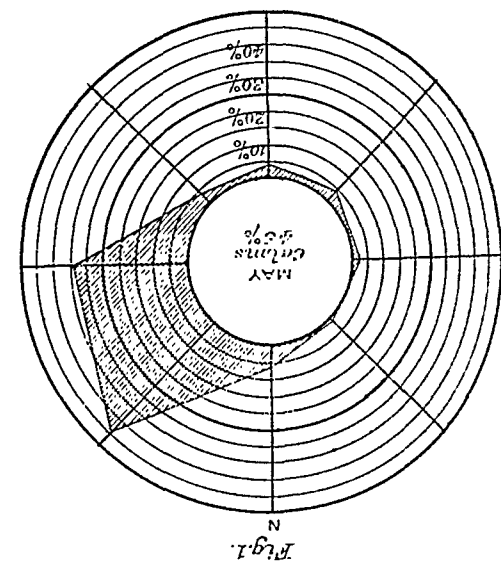


WIND ROSES SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS DURING THE MONTHS OF JANUARY TO APRIL AT DHUBRI.





WIND ROSES, SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS, DURING THE MONTHS OF MAY TO AUGUST AT DHUBRI.







WIND ROSES, SHOWING THE PERCENTAGE NUMBER OF CALMS AND OF MILES OF WIND IN EIGHT DIFFERENT DIRECTIONS, DURING THE MONTHS OF SEPTEMBER TO DECEMBER AND THE YEAR AT DHUBRI.

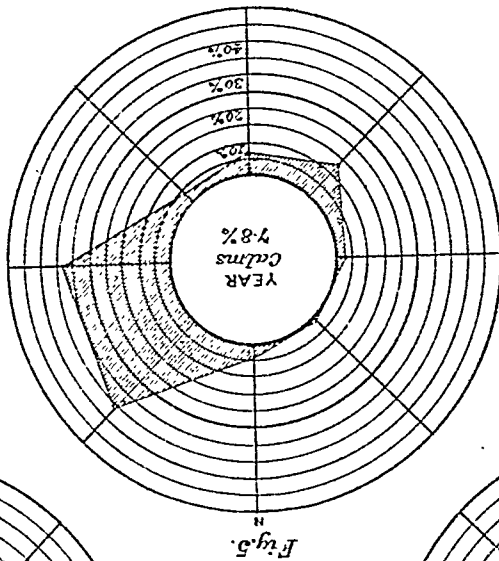
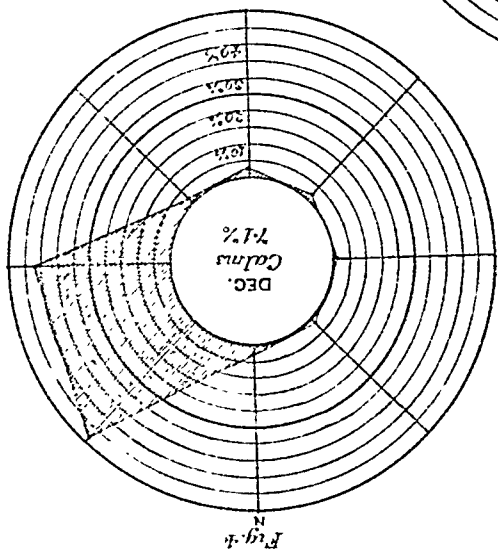
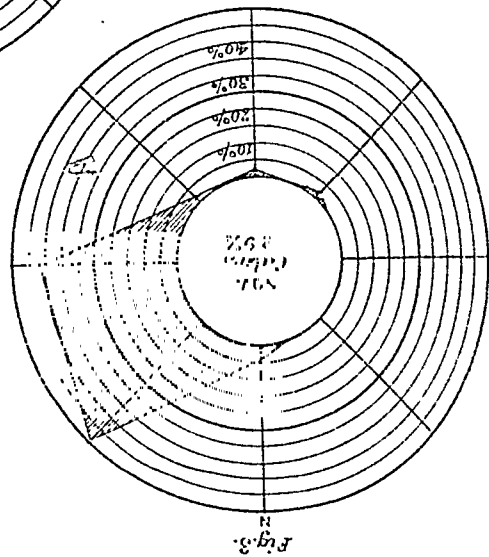
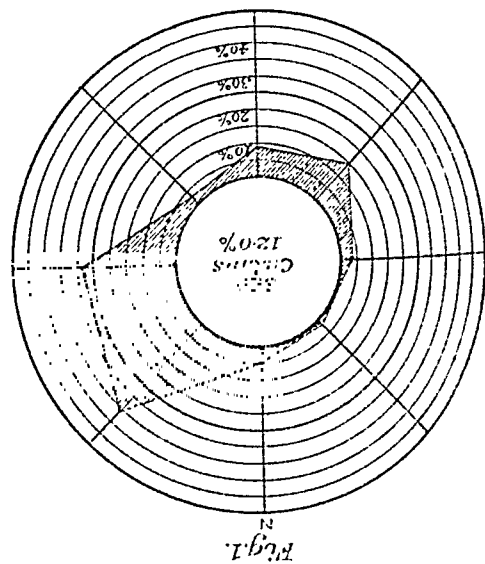
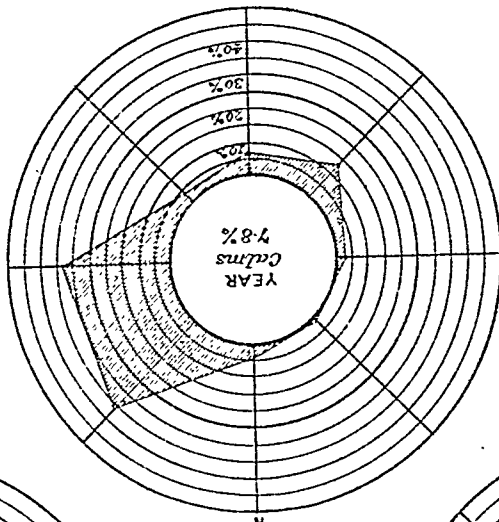


Fig. 5.



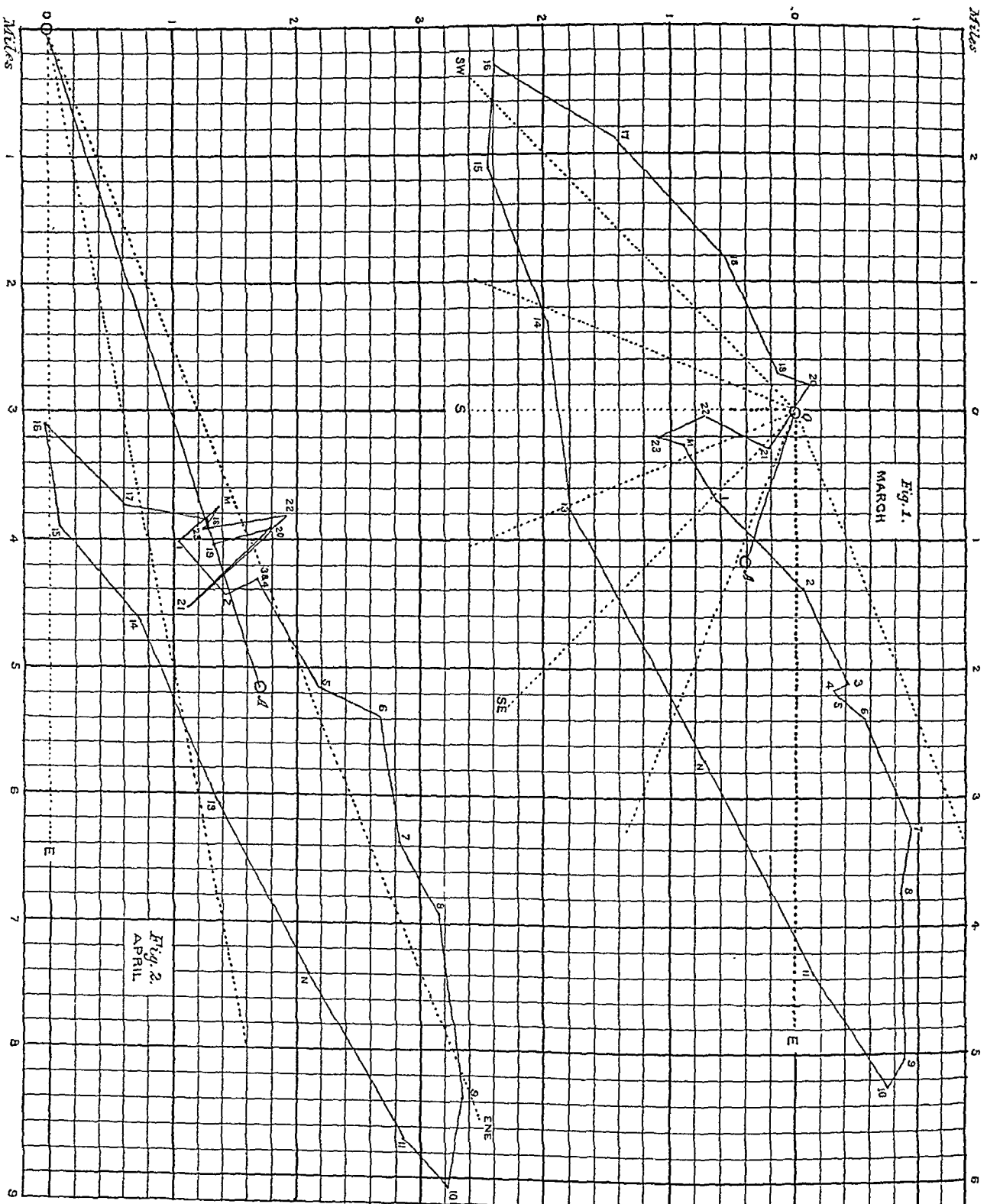






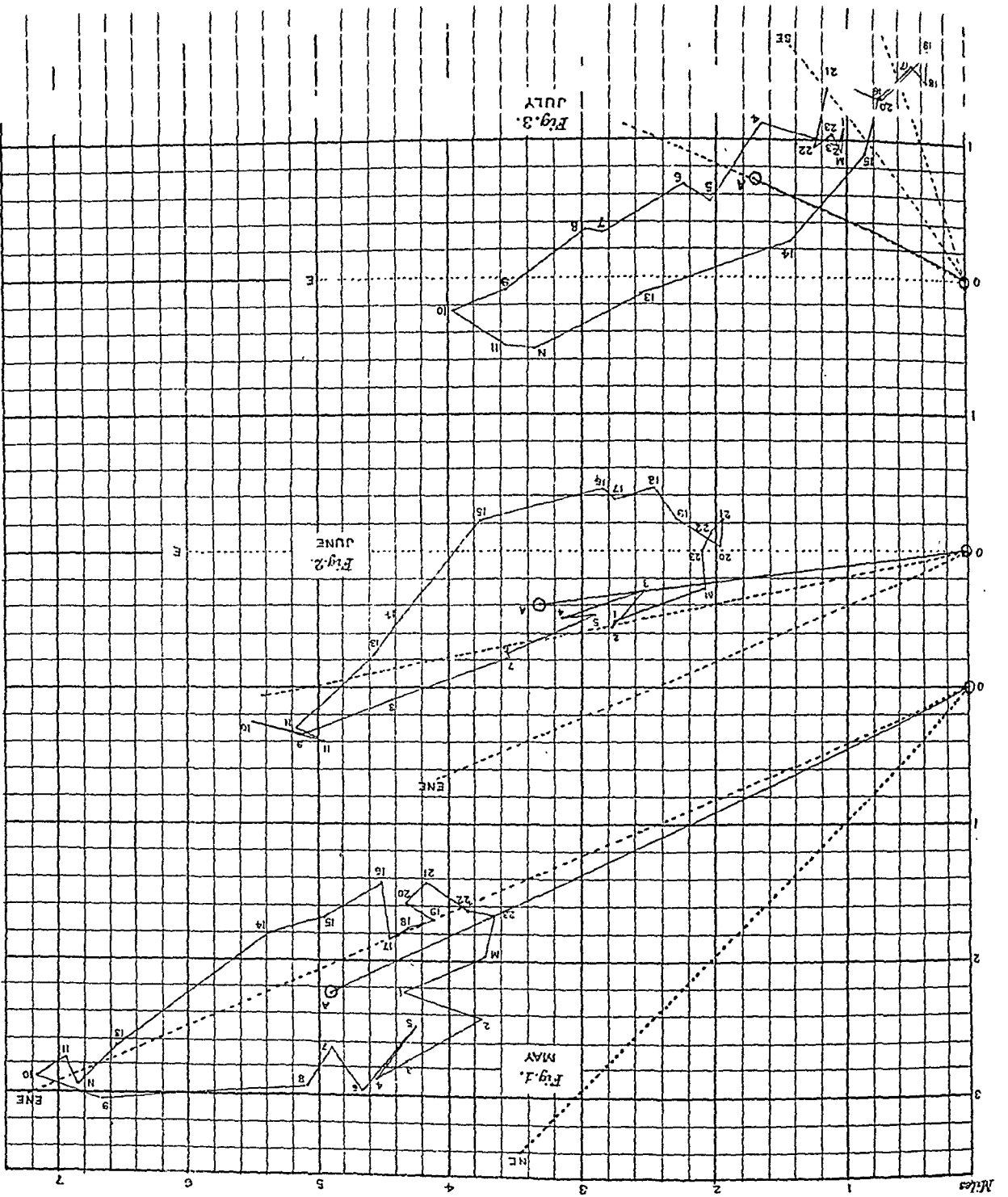
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MEAN DIURNAL VARIATION OF THE AIR MOVEMENT AT DHUBRI IN MARCH AND APRIL, SHOWING THE RESULTANT MOVEMENT DURING SUCCESSIVE HOURS.





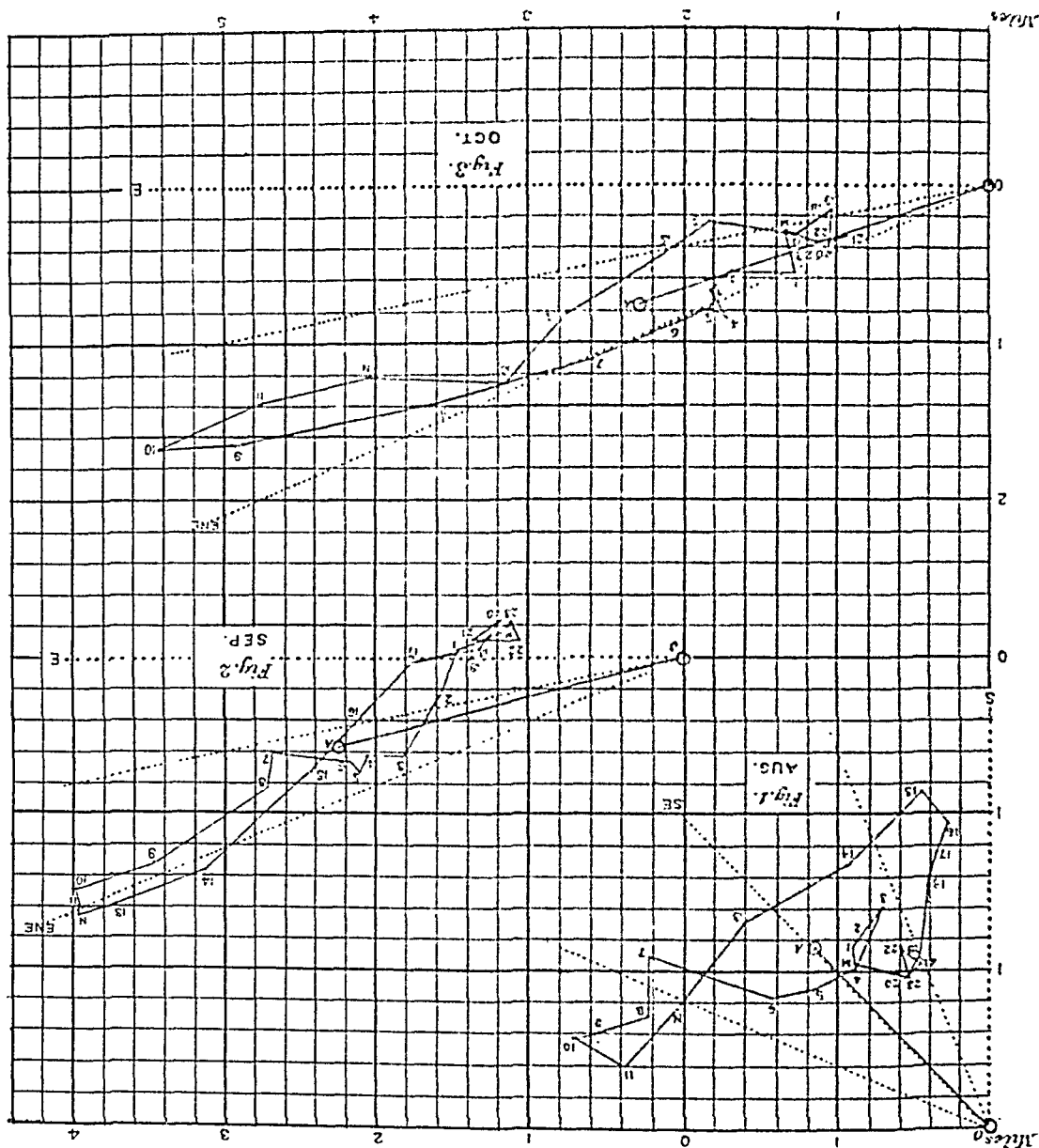
MEAN DIURNAL VARIATION OF THE AIR MOVEMENT AT DHUBRI IN MAY, JUNE AND JULY, SHOWING THE RESULTANT MOVEMENT DURING SUCCESSIVE HOURS.





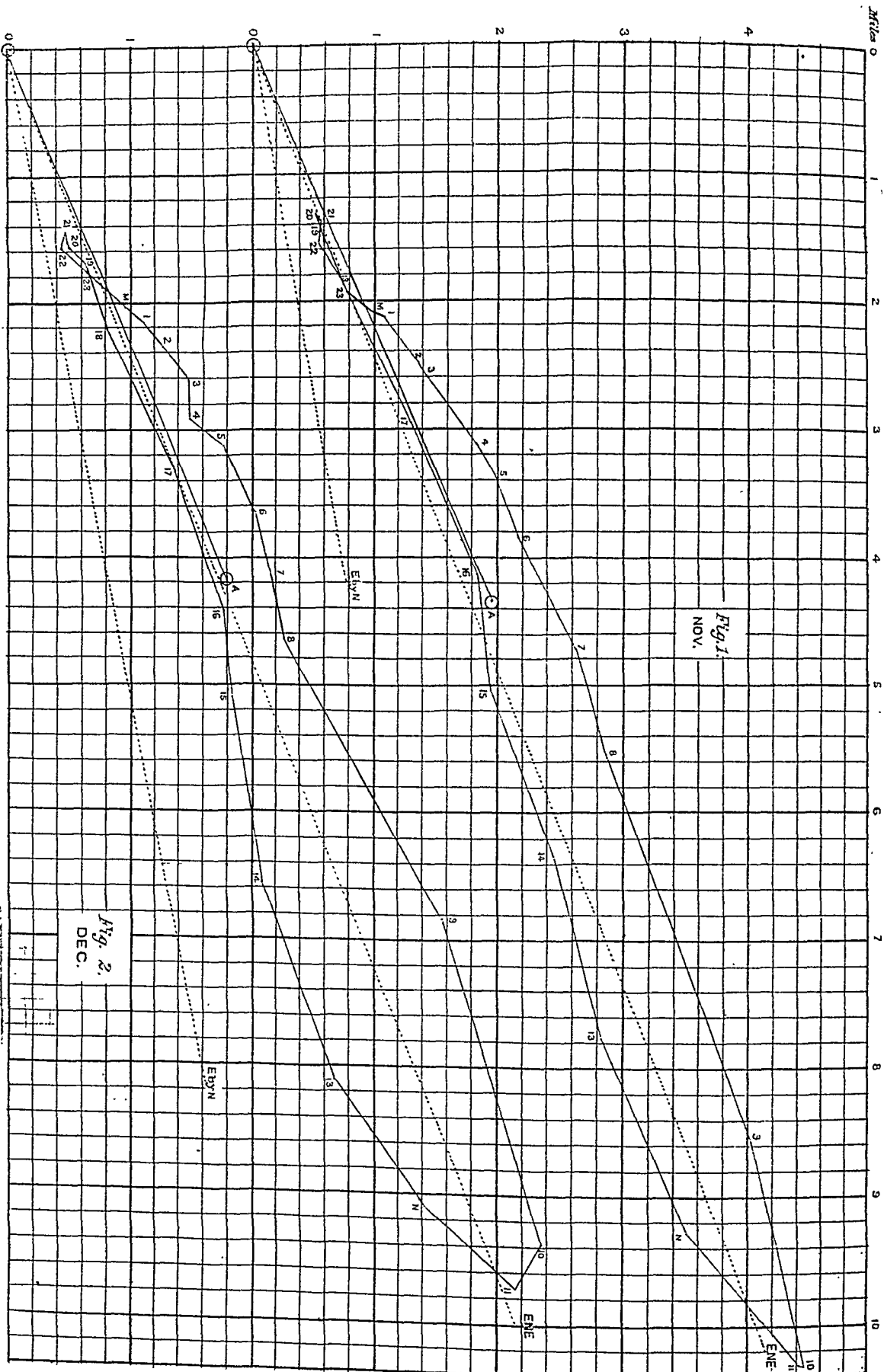


MEAN DIURNAL VARIATION OF THE AIR MOVEMENT AT DHUBRI IN AUGUST, SEPTEMBER AND OCTOBER, SHOWING THE RESULTANT MOVEMENT DURING SUCCESSIVE HOURS.





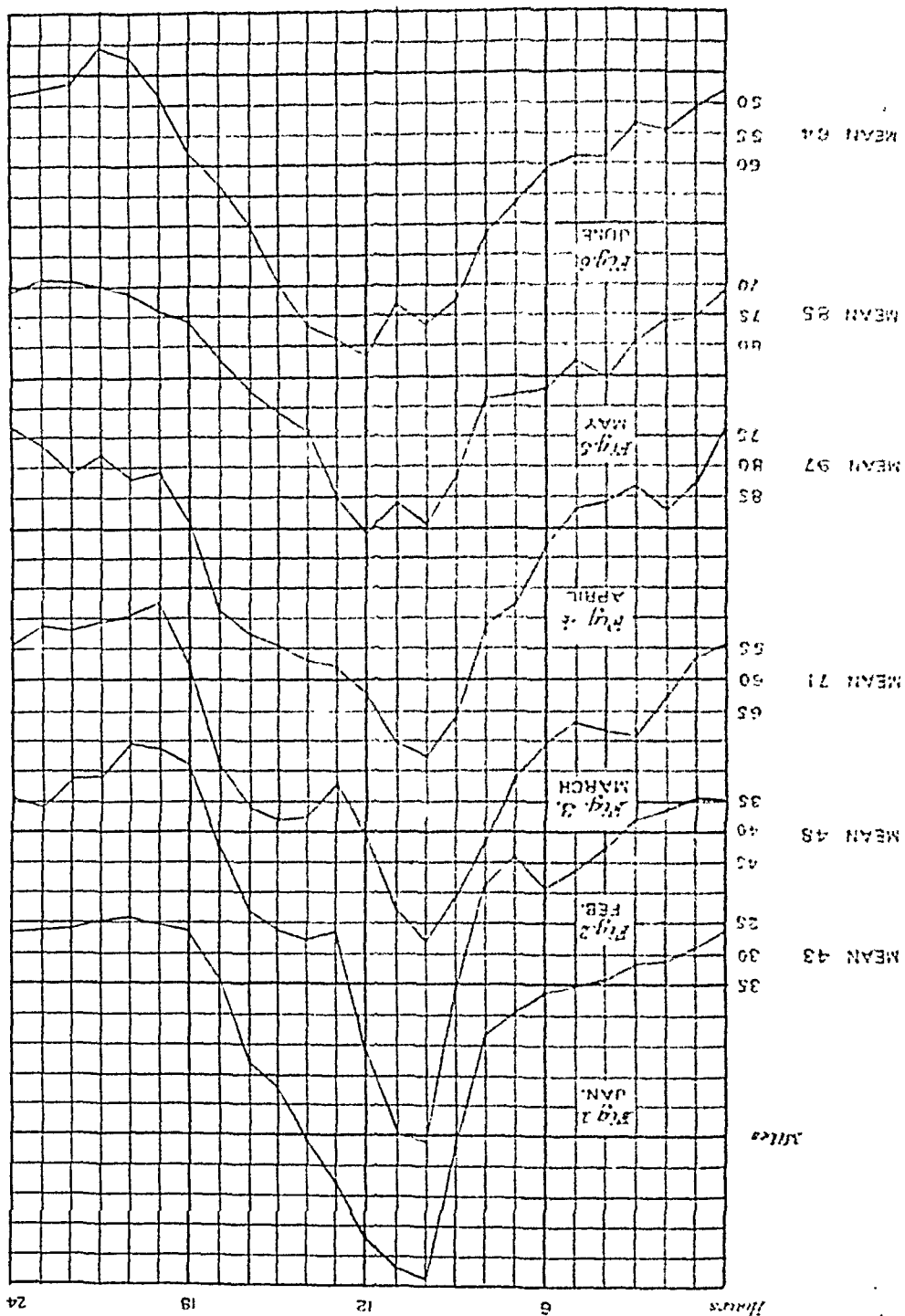
MEAN DIURNAL VARIATION OF THE AIR MOVEMENT AT DHUBRI IN NOVEMBER AND DECEMBER, SHOWING THE RESULTANT MOVEMENT DURING SUCCESSIVE HOURS.





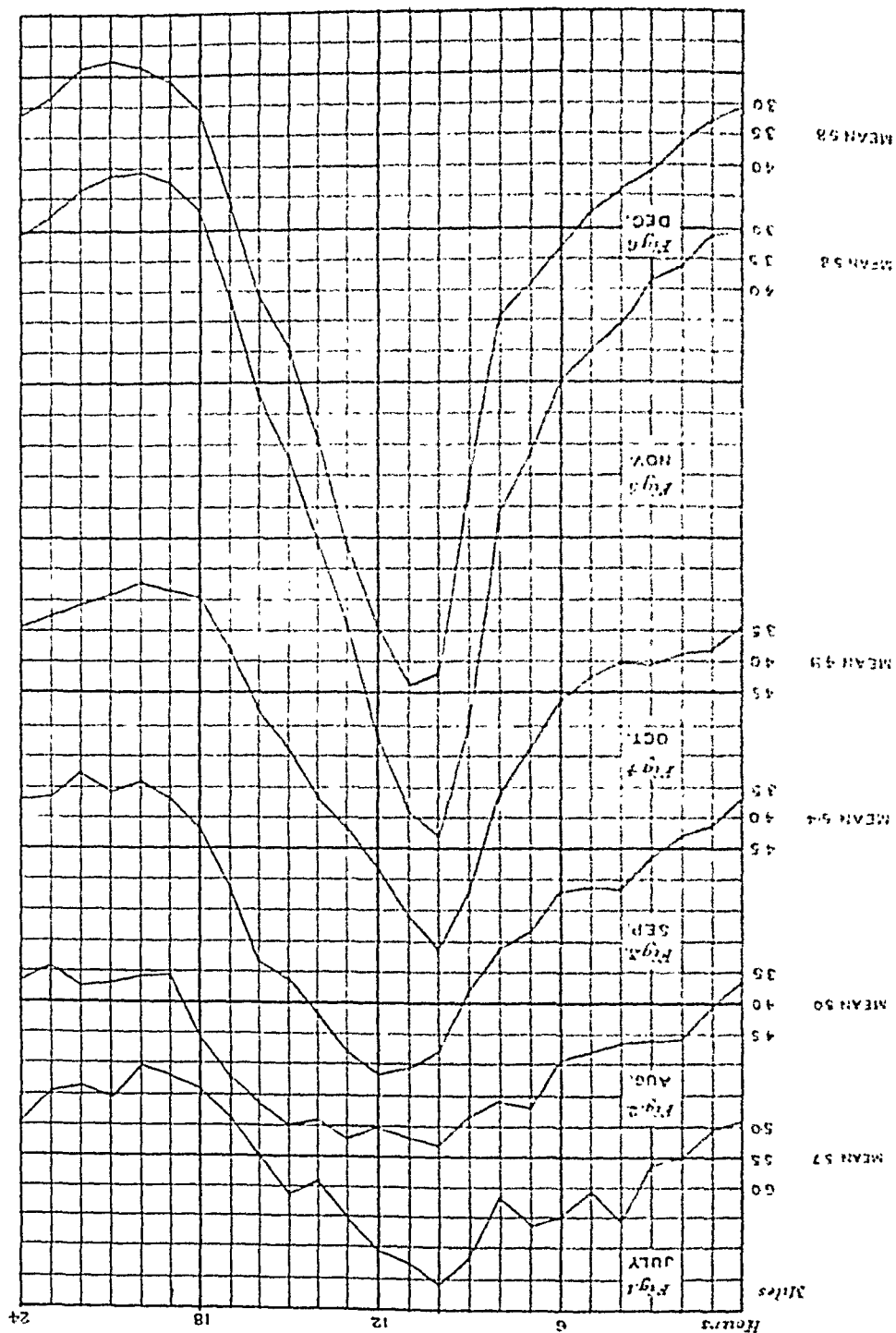
MEAN DIURNAL VARIATION OF THE WIND VELOCITY AT DHUBRI FOR THE MONTHS JANUARY TO JUNE, SHOWING THE TOTAL MOVEMENT, IRRESPECTIVE OF DIRECTION, DURING SUCCESSIVE

HOURS.





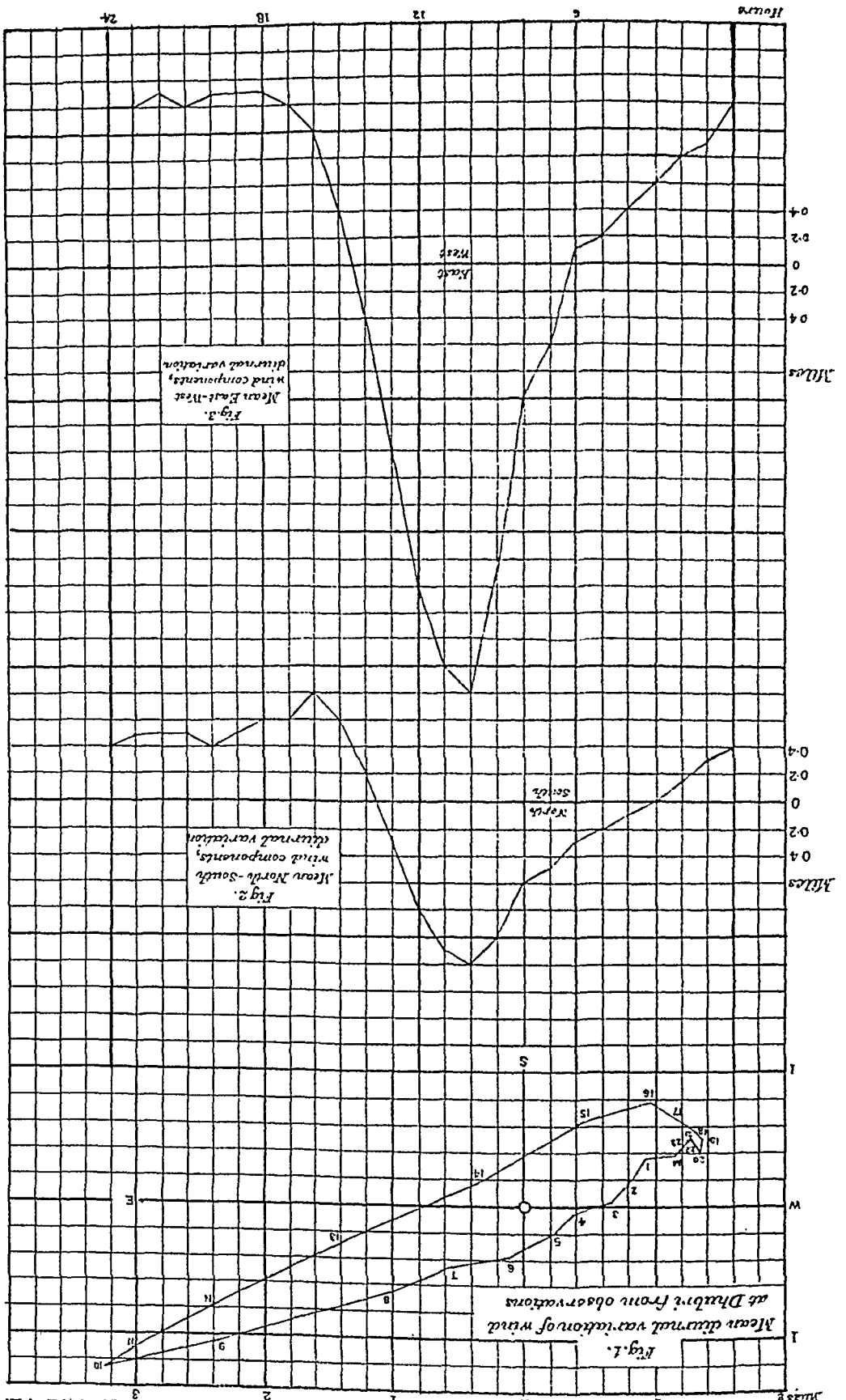
MEAN DIURNAL VARIATION OF THE WIND VELOCITY AT DHUBRI FOR THE MONTHS JULY TO DECEMBER, SHOWING THE TOTAL MOVEMENT, IRRESPECTIVE OF DIRECTION, DURING SUCCESSIVE HOURS.





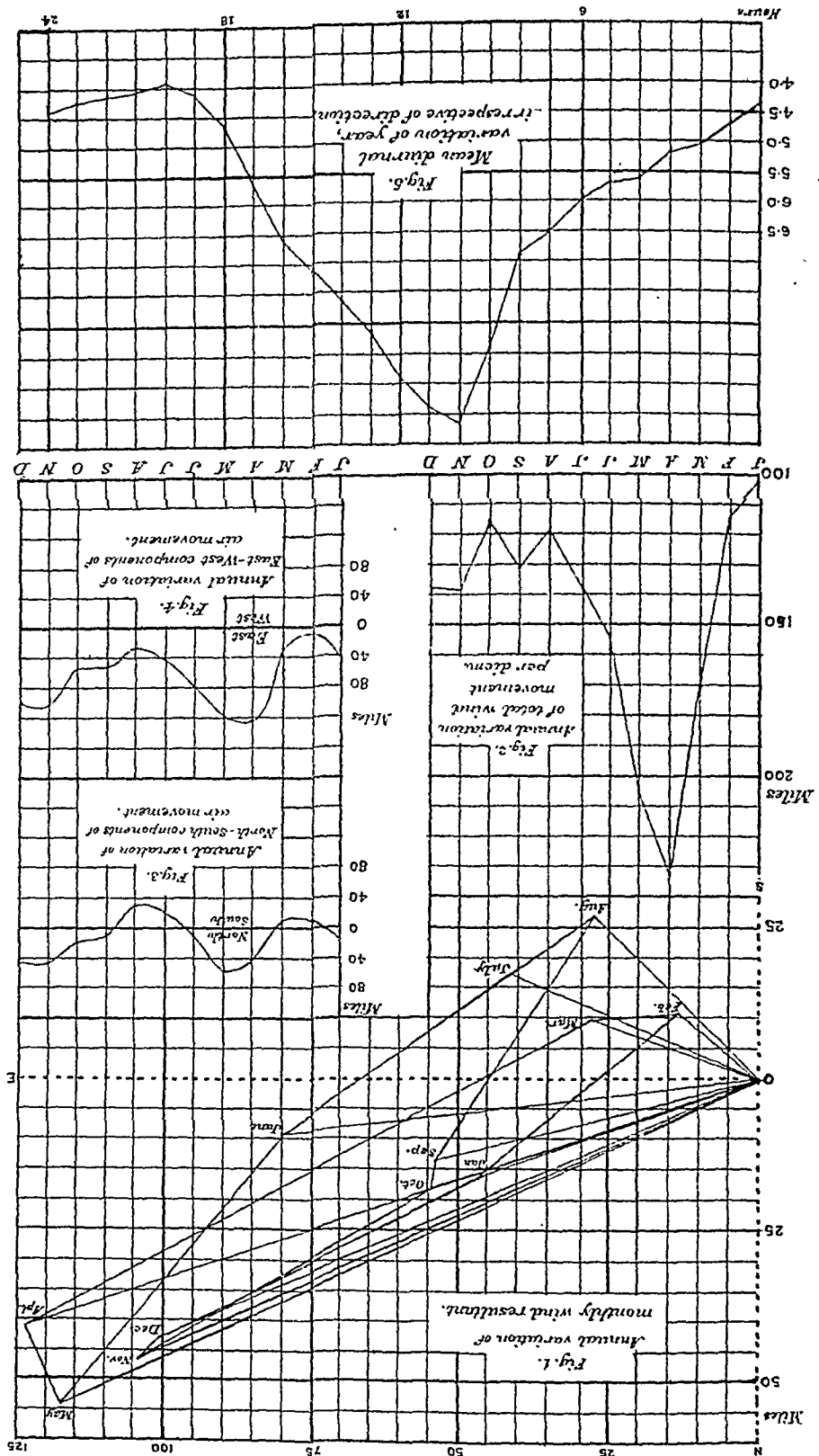


(1) THE MEAN DIURNAL VARIATION FOR THE YEAR OF THE RESULTANT AIR MOVEMENTS DURING SUCCESSIVE HOURS, ALSO OF (2) THE NORTH-SOUTH COMPONENTS AND (3) EAST-WEST COMPONENTS OF THE RESULTANT WIND MOVEMENTS DURING SUCCESSIVE HOURS ON THE MEAN DAY OF THE YEAR.



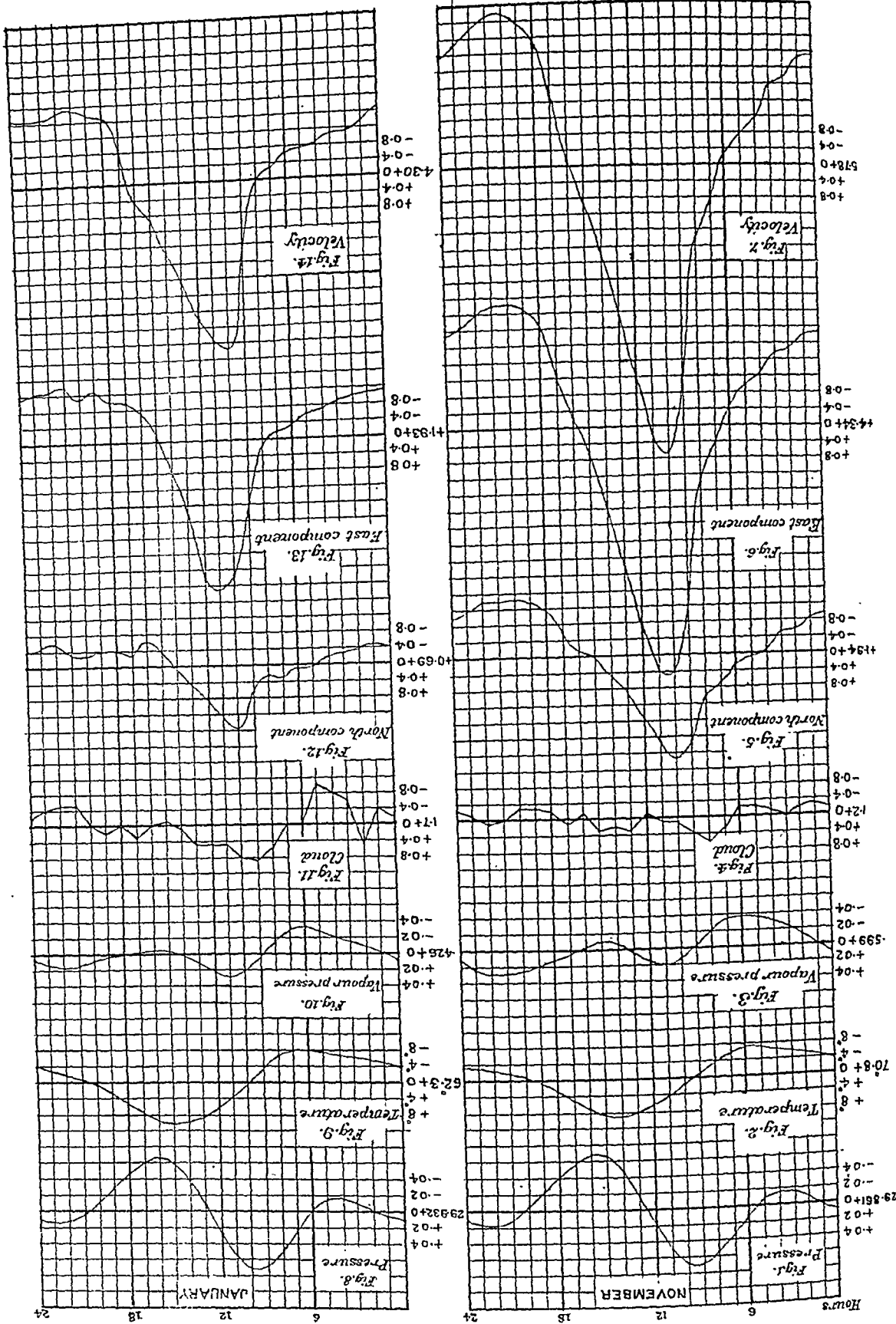


ANNUAL VARIATION OF (1) THE DAILY RESULTANT AIR MOVEMENT, (2) THE TOTAL DAILY AIR MOVEMENT, (3) THE NORTH-SOUTH COMPONENTS OF THE RESULTANT DAILY AIR MOVEMENT, (4) THE EAST-WEST COMPONENTS OF THE SAME, AND (5) THE MEAN OF THE WIND MOVEMENT, IRRESPECTIVE OF DIRECTION, DURING SUCCESSIVE HOURS OF THE MEAN DAY OF THE YEAR.





MEAN DIURNAL VARIATION OF PRESSURE, TEMPERATURE, AQUEOUS VAPOR PRESSURE, CLOUD, AND NORTH-SOUTH AND EAST-WEST COMPONENTS OF THE RESULTANT AIR MOVEMENT, AND OF THE TOTAL AIR MOVEMENT, IRRESPECTIVE OF DIRECTION, DURING SUCCESSIVE HOURS, AT OHUBRI IN NOVEMBER AND JANUARY.





MEAN DIURNAL VARIATION OF PRESSURE, TEMPERATURE, AQUEOUS VAPOUR PRESSURE, CLOUD, AND NORTH-SOUTH AND EAST-WEST COMPONENTS OF THE RESULTANT AIR MOVEMENT, AND OF THE TOTAL AIR MOVEMENT, IRRESPECTIVE OF DIRECTION, DURING SUCCESSIVE

HOURS, AT DHUBRI IN APRIL AND JULY.

